

**Bill Gates'
bid for your
living room**

21C

**Toffler and
information
monopolies**

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The electronic dream

**The curse
of e-mail**

**Teenage sex in
the AIDS era**

**Paul Davies
rethinks the birth
of the universe**

**Facing
the cancer
epidemic**

Hugh McKay on people and the info-tech dilemma

THE MAGAZINE OF THE AUSTRALIAN COMMISSION FOR THE FUTURE

Supporting education

As part of its continuing commitment to supporting educational initiatives, the Australian Commission for the Future is sponsoring 21C into secondary high schools throughout Australia. This issue of 21C magazine will be delivered free of charge to secondary schools in Queensland and the Australian Capital Territory.

Previous issues of the magazine were provided to schools in Victoria, New South Wales, South Australia and Tasmania. The Commission recognises the need for ongoing promotion of a greater awareness and understanding of a variety of public issues, including science and technology, sustainable development, and social and economic trends.

21C is an ideal vehicle for the promotion of these issues among children and young adults who comprise tomorrow's researchers and decisionmakers.

Message from
Hon Pat Comben
Minister for Education,
Queensland

"In a time of rapid change it is important for our young people to gain a sense of ownership of the future, and to appreciate that they can play an active part in its development.

21C offers students the opportunity to share in the work being done in areas such as science, technology and the environment. Visually attractive and intellectually stimulating, this magazine provides a view of possible futures, together with their implications, written by experts working in the field.

I am pleased to support its use in Queensland schools."

Message from the
A.C.T. Government

"The ACT Department of Education and Training is pleased to assist with the distribution of 21C and endorses its use in ACT schools."

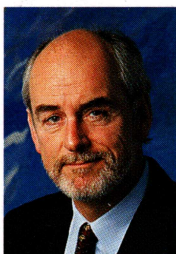
WE HAVE RECEIVED many requests to investigate the relationship between Australia and Asia. Will we profit from it? What impact will Asians have on traditional Australia? To compete in Asia, will we have to become Asian? Will we be secure? And so on. The questions are endless and could preoccupy this magazine for years.

Accordingly, 21C intends to increase the content dealing with Asia. Not that the magazine has ignored Asia in the past: we presented a fascinating feature on Japan only two issues ago. But in future we will provide a continuous stream of stories dealing with economic, cultural, scientific and political relations, and future directions in those relations. We will look to provide insights about opportunities in Australian-Asian relations, for Australians and our neighbors. And while the word 'Asian' is used here, this coverage will be specific in acknowledgment that the word 'Asia' creates a false impression of a homogenous rather than heterogeneous grouping of nations.

Increasing the editorial focus on Asia is also to acknowledge that probably the greatest changes taking place in the world at the moment, and for the foreseeable future, will be in Asian countries, from India to the Pacific. 21C will be concentrating on those changes and their future impact.

At the same time, 21C will continue to provide the sort of coverage that it has done to date, using experts to report on the newest ideas and developments across a wide range of fields.

Most Australians would not realise that all of the Asian countries with which Australia shares a growing relationship have recognised the importance of science and technology. Indonesia, Singapore, Korea, Japan, China and many others underline their commitment to scientific progress by



including science in a cabinet portfolio. Australia, which prides itself on its commitment to science, has at last fallen into line. The Federal Minister for Industry and Technology, Senator Peter Cook, is the first Cabinet minister with science included in his portfolio. Until Senator Cook, the science ministry was outside the Cabinet and accordingly enjoyed less influence over Government policy.

A note about subscriptions. Because we are a quarterly magazine, 21C is working hard to expand the numbers of readers who subscribe to

the magazine. Buying a subscription ensures that you receive all four editions a year. Our research shows that over-the-counter buyers of the magazine miss out on at least one issue a year. Do yourself a favor by taking advantage of our generous subscription offer – five issues, including postage, for \$40. 21C readers are smart enough to know that this puts them well in front.

Happily for the future of 21C, subscriptions have risen at a rate close to 50 per cent a year over the past three issues – an extremely healthy growth rate. This is good news because it means the magazine will continue to have the resources to do its job. ★

Check out the future now.

Subscribe to 21C

At \$40 for five issues (for individuals), **21C** represents tremendous value for those concerned about the world around us and the future we face. **21C** is Australia's only magazine devoted to publishing the ideas and endeavors of people working at the leading edge in their chosen fields. It is an indispensable aid if you want to know about the really important issues.

Look for the subscription brochure inserted in this issue of **21C** or ring us on 03 663 3281 to make an order.

If writing, our mail address is **21C** magazine, GPO Box 1612M, Melbourne 3001. e-mail: subs@21c.com.au

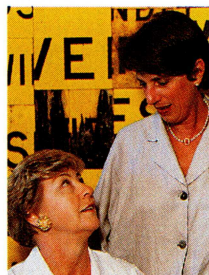
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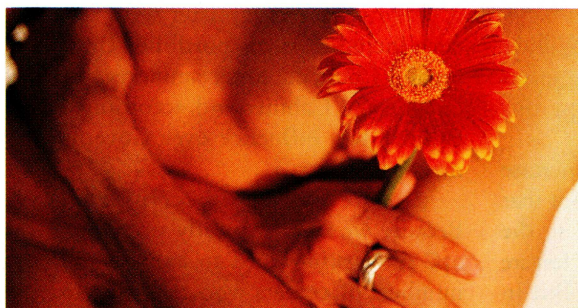


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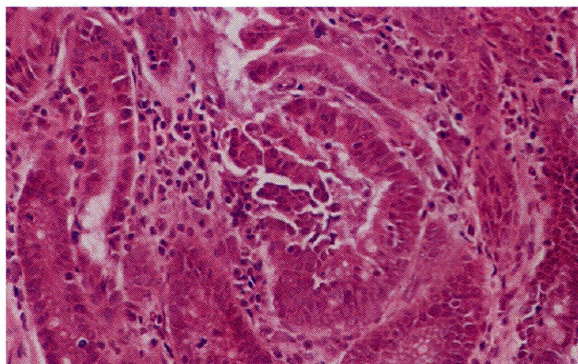
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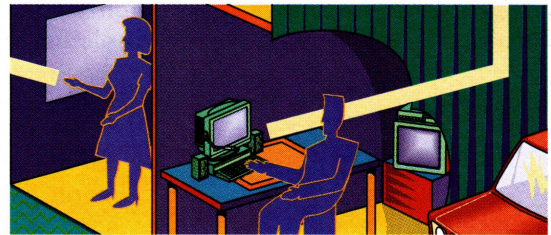
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Don Hewett

The electronic dream

THE FIELD KNOWN AS Information Technology is evolving rapidly, so rapidly indeed that the ability to design and build new technologies now completely outstrips the ability to mass produce and market them.

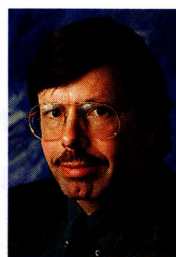
This is not just a challenge for IT companies making major investments, which must eventually commit to a technology, a product to sell; it is perplexing for the people at whom the new technologies, and marketing pitches, are aimed.

A new lexicon has appeared, with words like cyberspace, broadband and digitization; new terms like e-mail, CD Rom, interactive multimedia, fibre optic, fibre centre, digital compression and information superhighway; and new meanings for familiar words like convergence, chip, bit, platform, intelligent, network, compatibility and smart.

But it is the new concepts driving the change that place the greatest demand on understanding. These are being rushed off the mental production line so frequently that 'dinosaur' mediums like print can hardly keep up. Even daily papers find it difficult to report the changes, so it would be tempting to think that a quarterly would be asking for trouble.

However, the reverse is true. While technologies reaching the market have already been superseded before you get them through your front door, the implications, the significance of these changes, and the impact on society, are profound – and analysing them requires deliberation, penetrating insight and thought.

The question is how, or rather who? For a world perspective on the changes,



21C sought out Alvin Toffler, author of *Future Shock*, and Bill Gates, billionaire founder of Microsoft. Sandy Plunkett conducted her first interview with Toffler – by phone – while he was stopped over in Paris, and her sixth interview with Gates during his fleeting

visit to Australia.

For an Australian perspective, we asked noted social commentator Hugh McKay, and ANU Visiting Fellow and *Prometheus* editor Don Lamberton, to contribute, and for a review of the technological changes ahead, Peter Gerrand, Professor of Telecommunications at RMIT.

To put the IT picture clearly, we also sought the services of computer graphic artist Norm Robinson (see illustration here and pages 65-68), working from a concept outlined by Robert Jolly, General Manager, Beatty Communications.

Together with several other authors, these people have provided an absorbing, comprehensive, and readily comprehensible IT section for 21C's demanding audience. It will make the meanings of all the new words, terms, usages and concepts outlined above, clear to anybody who has so far found themselves in an unfamiliar world.

This issue is also about teenage sexual attitudes, and the alarming messages this age group receives from teen magazines, and the story of the cancer epidemic and new forms of treatment, both important social issues about tomorrow's world.

Fittingly perhaps, we round off with a look at the past, indeed the very beginning of the Universe itself, in a compelling piece on the origin of everything, from Australia's pre-eminent physicist/author, Paul Davies. ★



WEDGETAILED SPARROWS?

Sir,

Congratulations on a great magazine. I am enthralled and yet have one small problem about it to which I must have an answer.

How on earth do you get the Blackfaced woodswallows (*Artamus cinereus*) on page 77 to grow up to be Wedgetailed eagles?

B Weston
Boronia, Victoria

FLAVOR SULLIED

Sir,

Over here in Cambodia, I had been awaiting my first issue of 21C (Summer 1994). Imagine my feelings of disappointment when, after reading the first letter to the editor asking for previously-published sexist language to discontinue, your response as editor, was to quibble.

The flavor of your magazine has been sullied for me. It's very frustrating to find that such an excellent and

informative magazine is being edited by someone who hasn't yet understood the importance of using inclusive language. There are many excellent books available on this subject. For your own sake, and the sake of your readers, please seek them out.

P.S. As I was hunting for your address, I noticed more evidence of your petty rebellion. Robyn Williams is cited as being your 'chairman'!!! 19C more like!

Barbara Garner
Prek Leap Agricultural
College
Cambodia

GENDER-INCLUSIVE LANGUAGE

Sir,

As a science educator and a long-term 21C reader I felt that your comments on a letter by Ms Rebecca Wigney in the latest issue of 21C ('Mankind' *Gender Biased*, Summer 1994) should not go unchallenged.

Science educators should

promote gender-inclusive language because of the low participation rates of females in science as a career, and the perception by females that science is a male-only domain. This latter aspect is reinforced by images of the 'maleness' of science reflected in the media. Our intentions are not to strive for 'political correctness' but to ensure that 50% of the population, the female portion, is not excluded from participating in science and technology.

21C has a wide readership throughout Australia and I believe you have a responsibility to ensure that the diversity of your readership is strengthened by employing strategies for their inclusion. These strategies include the use of gender-inclusive language, articles by female scientists who can be portrayed as role models and interviews with more female scientists.

Michael Michie
Darwin, Northern Territory

NEW-LOOK 21•C TOO EXCLUSIVE

Sir,

I first saw 21C when its second issue captured my attention from a shop shelf. It struck me as a magazine which wanted to promote science to the general community by capturing interest through the large, open layout and the colorful presentation which made it stand out as different from other magazines. At thirteen years old, my mother gladly promoted my interest in the magazine and I soon became a regular reader.

Even though I understood that the magazine was aimed at adult readers, I found that the content was in most cases simply put,

had a range of topics which made interesting reading, and I also discovered they held great research material for school assignments. The positive view that the journal took of the future was a breath of fresh air in a world which is increasingly stressing the negative and ignoring the good.

Now that 21C has undergone its image change from a "mail order catalogue" to a "serious journal" (as one reader put it), in my mind it is another sad example of science and technology being reserved for the professional group of readers rather than the public who must be attracted to it as an interesting new field. I strongly hold the view that for science to appeal to the general community, it must not only be comprehensive and informative, but open and eye-catching.

I am sorry that you abandoned the appeal of your magazine to suit the portion of readers who see science and the future as an exclusive field.

Tania Ritchie
Seaham, New South Wales

WORD FROM HOME

Dear Sir,

Excellent publication. Complements the information I receive via New Scientist, Scientific American, Science, Nature and La Recherche. Besides it keeps me in touch with my father's country and the home of many friends.

All best wishes for a happy New Year and a continued success.

P.S. Several friends in the Argentine Chemical Association read my 21C.

R Craig
San Isidro, Argentina

e-mailTo: ed@21c.com.auSubject: *'Mankind' gender biased*

Sir,

Your response to Rebecca Wigney's letter (21C, Summer 1993/4, p.5) contains an important factual error. 'Humankind' does not contain the word 'man' any more than 'maniac' or 'mantle' do. It contains the Latin-derived word 'human' with the Germanic suffix 'kind'. 'Human' may be ultimately linked with the Latin words 'homo' and 'hominem' – words meaning 'man' – but in English it no longer carries any connotations of masculinity, and thus need not be transformed into 'huperson'. What would we do then with words like 'humanities' and 'humanism'?

However, as a non-sexist substitute for 'mankind', I would prefer 'humanity' or 'the human race'.

What we probably should do with 'woman' is leave it alone, unless you want to go along with some feminists who spell it 'wimmin'. Nobody thinks of a 'woman' as being some kind of 'man', anymore than they think of a 'bridegroom' as being some kind of 'bride'.

Giles Martin, ulgsm@dewey.newcastle.edu.au

Catchment Impacts

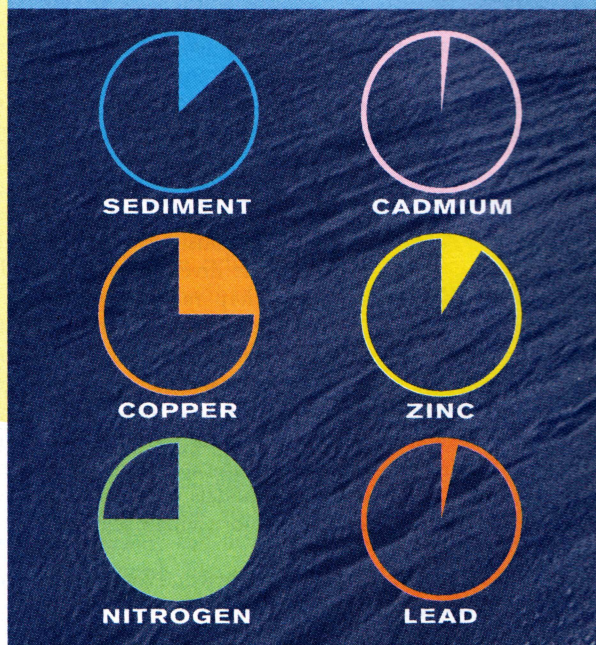
We are now beginning to recognize that stormwater runoff is potentially more damaging to the environment than treated sewage effluent.

Living cities

Cities are like living things. They take in resources which they use and change, they grow and they produce wastes. Large cities make massive demands on the surrounding land from which they draw resources – water, electricity, food, building materials, oil etc. They also discharge huge quantities of wastes to the air (smoke, dust, green-house gases), to water (factory effluents, treated sewage, stormwater), or to land (garbage, rubble, used products, packaging). These wastes can cause serious levels of environmental pollution.

Point sources of pollution

During the past 30 years, Australians have become increasingly aware of, and concerned over, the



Comparison of Bay Pollutants. Background represents contribution to annual load from the Yarra River, colour segments represent contribution from Werribee Treatment Complex.

impacts of pollution. In 1970 a Senate Select Committee documented the appalling condition of our urban waterways. Shortly afterwards, Environmental Protection Agencies were set up in each State to tackle the growing pollution menace.

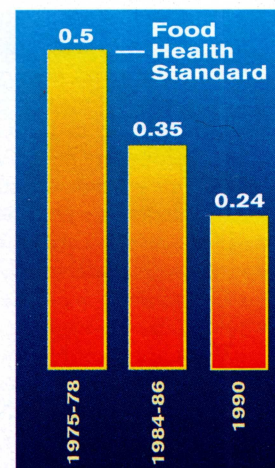
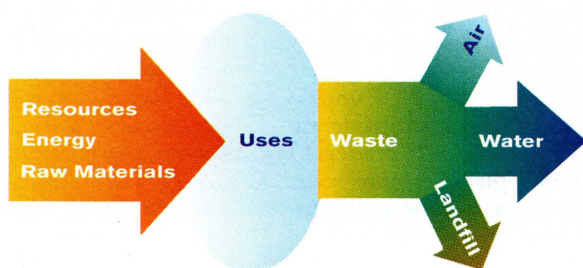
Logically, these EPAs first paid attention to the 'obvious' discharges or point sources of pollution. In Melbourne, for example, most industrial wastes have now been connected to the sewer to ensure that potentially harmful wastes are treated before discharge to the environment. A large number of unsewered properties was also connected to the sewerage system, reducing waterway pollution from urban sillage.

As a consequence, there

has been a measurable decrease in the level of pollution reaching Port Phillip Bay. This is illustrated by the decrease in the levels of mercury in flathead taken from the Bay. Our waterways and the Bay are now healthier than they were when we first studied them in the early 1970s despite the increased development in the Bay's catchment.

Diffuse sources of pollution

More recently we have become aware of a more troublesome problem – the



Mean mercury concentrations (ug/g wet weight) in flathead from Port Phillip Bay.

pollution of waterways from many small sources (roads, shopping centres, backyards) around the suburbs which is transported to local waterways and the Bay by stormwater runoff.

In contrast to the sewerage system, (where wastes are removed or are treated before discharge to the environment), urban runoff in most Australian cities is discharged from the drainage system without treatment of any sort. In Melbourne, there are around 1000 drains that discharge to the environment, polluting our creeks, rivers and the Bay. As a result of studies both here and overseas on pollution loads in urban runoff, we now know that urban runoff can contain higher loads of pollutants than treated sewage effluent.

Runoff impacts

Since the 1930s, the quantity of urban runoff from Melbourne's suburban streets, roofs, gardens and open space has increased 500%. We now need to manage over 950 megalitres of runoff each year, five times more than the amount of sewage that is treated (180ML). As urban runoff passes over a variety of surfaces, it becomes contaminated with pathogens, nutrients, litter, suspended solids and toxicants. For example, an estimated 25 tonnes of lead (from sources such as motor vehicle exhausts, roof plumbing and flaking lead-based paint) finds its way into the Bay each year from stormwater runoff.



Dealing with pollutants in stormwater requires a different approach to the 'point source' regulations on which we relied in the past.

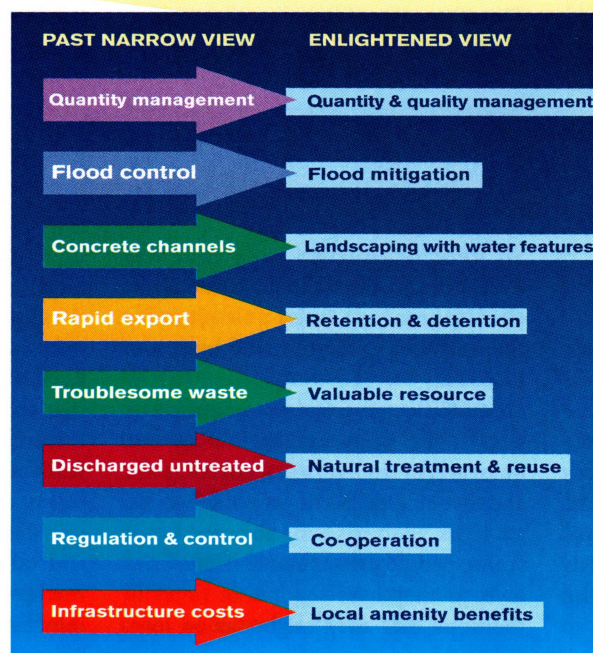
Co-operation

As diffuse source pollution results from the actions of millions of people all across the suburbs, reducing these pollutant loads will require the co-operation and joint action of all of us – at the community, municipal and agency level. Now is the time to start. Around the

world, cities like Melbourne are tackling diffuse pollution by making use of new planning and management practices referred to as 'Best Practices'.

Best Planning Practices (BPPs) encompass the use of smart design at the house lot, precinct and neighbourhood level. BPPs can be taken up by local councils who exercise planning control and are most effective for new development. Combining BPPs with effective pollution control technology

(Best Management Practices or BMPs) in urban water management brings this complex jigsaw together to provide solutions which are efficient, sustainable and attractive. Building water into the local landscape enhances local amenity and adds monetary value to houses and real estate. Many progressive municipalities and land developers have already started to use these ideas to improve the quality of their developments and to reduce the cost of expensive infrastructure. As housing costs are a major driver of the economy in Australia, perhaps the more economical BPP/BMP approaches can help introduce a competitive edge to Australian cities.



Teenage sex in the age of AIDS

Teenagers are having sex earlier in life and, in the case of girls, having sex more often than in past generations. Being sexually experienced at 14 is no longer seen as deviant behavior. But do 14 year olds have the maturity for sexual intimacy in the era of safe sex? Melbourne psychologists Susan Moore and Doreen Rosenthal argue in their new book, *Sexuality in Adolescence*, that the young would benefit from learning more about sensuality before sex.

The two spoke to Jenny Brown.

One of your findings shows that the age of "sexual debut" is declining. How sexually active are modern teenagers compared to generations who have gone before, and what is bringing about those changes?

ROSENTHAL: Looking at research into the sexual revolution of the 1960s we found there was indeed change in that young teenage girls are engaging in more sexual activity now than in the pre-60s era. The male level of sexual activity has roughly stayed the same but the age of debut has certainly decreased.

MOORE: The problem here is that it's an average and when you look at an average it covers a huge range of behaviors. There are still lots of 21 year olds who are virgins but there are also some 13 and 14 year olds who are not virgins and will say it quite openly. That's a big change. Twenty or 30 years ago, a 14 year old non-virgin would be seen as a deviant. Now in some groups, that is certainly not seen as deviant behavior.

Has anything really altered in the way the genders are relating to each other. For example, are the girls more assertive?

ROSENTHAL: No. We've found a mixture among the girls. Yes, there are girls now who adopt fairly positive attitudes to their sexuality and reasonably permissive attitudes. But there is evidence of a strong double standard. Some girls still feel that it's important for girls to be virgins. And boys? Well it's OK to sleep around and sow their sexual wild oats. What has come out quite strongly is that the gender differences still exist.

MOORE: Findings indicate it could actually be harder for girls now because there is an expectation of permissiveness, especially in the 17 to 18 age group. There is a deal of ambivalence for a lot of girls, an idea that if they don't have sex by the time they're 17 there is something wrong with them. However, unless they put around it all the trappings of love and romance, then they're sluts. So they're not having sex for practice, as is sometimes the case for boys.

ROSENTHAL: This has important implications because we find girls tend to regard a relationship more readily as a love commitment than do boys, and we've argued that this is in order to give themselves permission to be sexually active.

MOORE: Even the homeless girls were very into love, romance and commitment despite the fact that many of them had had dozens or even hundreds of partners. Romance wasn't the reality of their sex life but it was part of the fantasy – the ideal that they were still looking for.

So here is another idea that has been transported through the ages, that females need to justify themselves as an object of love, not just sex.

MOORE: Boys were also romantic but not to the same extent. There is a question here. Are we separating sex and love in a different way than we did 20 years ago? It seems today a lot of young people use sex to see if they're in love, so they have sex lots of times in the hope that they might fall in love.

Whereas 20 years ago you might fall in love lots of times and then you might be able to have sex.

You make the point that although healthy sexuality is a developmental task of adolescence, sexual initiation can occur too early. What do you mean?

ROSENTHAL: One Australian study indicates that 10 per cent of girls and boys have their first sexual experience before the age of 13. It seemed to us there is a lag in terms of what they're physically capable of and their psychological development. We argue that sex and intimacy are entwined and that, at 13, kids don't have the psychological maturity to deal with it. It's quite hard at 13 to say "No. I don't want to do this" or "No, I'll only have sex with you if you use a condom."

Are kids and even older adolescents managing their sexual expression or are they floundering while trying to "act out" physical behaviors they believe are expected of them?

MOORE: The media is so full of sex these days that it is hardly surprising kids grow up thinking sex is what you do all day. It is a major part of life but not what you do all day.

ROSENTHAL: Part of the problem is that the media is where they get their information from. From the movies, from television. Girls' magazines are full of issues around sexuality but the girls rarely get the chance to sit down and talk about sex with their parents, teachers or peers in a way that is truly informative rather than biased.



Is the media the main teacher of sex?

ROSENTHAL: It has a very profound influence. You don't usually see your mother or father, your friends or siblings having sex.

MOORE: But in films you see all these bodies writhing to music and all the blissful expressions, rather than the sort of fumbling foreplay of first efforts.

Do you get any sense that they are getting genuine gratification from

being sexually active, or are they simply doing what they feel others want from them?

MOORE: In some of the girls we interviewed we got a sense of them feeling confused or exploited. It wasn't a huge thing but some girls were saying "This isn't fair" or "Why is it that when girls give up their virginity they're sluts, but it's alright for boys?" There is also that data showing that more of

their age group are having sex than is actually the case. They have a distorted idea.

ROSENTHAL: But too, there were girls who were quite comfortable with having sex. They didn't express any sense of being exploited or losing out in some way. And equally there were some boys who expressed concerns along the way of, "I don't really want to do this but how do I, as a male, negotiate that?" There was as much pressure for a

*"Young teenage girls are engaging in more sexual activity now than in the pre-60s era.
The male level of sexual activity has roughly stayed the same."*

male to be sexually active. But there are also kids who are negotiating sexual activity without any difficulty.

What is the difference between the two groups?

ROSENTHAL: We didn't tackle that question but in data one of my students has come up with, she found a number of different sexual ideologies. She found "sexually competent" people who have a high degree of self esteem as sexual people. They're not anxious about sexuality. They are moderately interested in being committed but it is not the be-all and end-all. They feel confident about their ability to deal with sexual matters.

What we're really trying to do now is see what it is that causes kids at age 15 or 16 to feel sexually confident, or not. It's a very important question.

Do different cultural or ethnic mores affect the expression of sexuality? Are any particular population sub-groups succeeding in shepherding their adolescents through a "healthy" phase of sexual exploration?

ROSENTHAL: The use of the word "healthy" is very difficult because there are certainly some groups where obviously the cultural norms are about not being physically sexually active before marriage or, until you are older. We certainly found evidence among Chinese-Australian kids that they were less sexually active than the Australian kids. For them, being sexually healthy is to delay sexual activity until you're older. For others, healthy sexuality is to experiment.

MOORE: It's not even necessarily an ethnic cultural thing because there are different groups of kids with their own sexual mores and adolescents will fit in and feel comfortable within the mores of that group. So even within the same school you'll find a group that are sexually active and a group – 'the nerds' – who are not. But both each might be

quite comfortable with their sexuality.

ROSENTHAL: Healthy sexuality has to be contextualised. It is not so much a function of the behavior they're engaging in but their readiness to engage in that behavior; that there wasn't a power, a coercive element behind what they're doing.

Are schools helping here?

MOORE: Some schools are trying to teach kids to be more assertive about their sexuality in the sense of safe sex. I don't know whether many schools are teaching kids how to ask for what they want sexually.

What influence can parents really have on teenage attitudes to sex?

MOORE: I don't think it's very easy for parents to talk about sexuality with their adolescents if they've never done it before – if there hasn't been an on-going dialogue. But it's not only the talking, it's also the doing.

ROSENTHAL: They're the sorts of things we're now beginning to explore, the ways in which parents are modelling sex. We had a very interesting quote from one girl saying that it isn't what parents say, but what they do. If you've got a mum who brings a different boyfriend home every night of the week, that's telling you something about the nature of sexuality. Talk and behavior have got to match.

MOORE: Some writers say that talking about sex with your parents has some elements of inappropriateness to it. It's OK talking about values but you don't ask your parents, "After I touch her breast, what do I do?" That is inappropriate because it's cutting across the incest barrier. So it is appropriate to talk about some things with peers, and some things with parents.

Where do the peers stand in this? In my day, 20 years ago, the peer pressure around sexuality was very strong.

ROSENTHAL: That's still the case; peers are still important.

MOORE: Peers can be a positive influence as well as a negative. They do pressure you but they also provide support and comfort. You can talk to your girlfriend for hours about what you think and that's very helpful emotionally.

What is known of the relationship patterns among today's teenagers? It has been suggested that to many, a long term relationship is one that lasts more than a few weeks.

ROSENTHAL: The term 'serial monogamy' ought to have been coined for adolescents. It is still the case that young kids are willing to accept as regular and committed, a relationship that as an adult you wouldn't. That's a real worry and it goes along with what we said earlier about young girls needing to define a relationship as a love commitment.

MOORE: We found in one very large sample of 18 year olds that the mean length of a regular relationship was about six months. But we also had people saying two weeks and others saying not till they were married – so there is enormous variability.

On the monogamy question: If you are in a stable relationship would you expect your partner to be monogamous? Everyone says yes. But would you expect yourself to be monogamous? Nearly all the girls say yes but a lot of boys don't expect themselves to be monogamous, especially in certain groups. Certain boys believe it's OK to play around, that's part of being a boy.

Were the boys willing to be honest. Will they say they've been with someone else?

ROSENTHAL: We didn't ask them directly but my hunch is some would be up front about it if asked. I think it's likely that some girls wouldn't want to know the answer so they wouldn't ask.

"The media is so full of sex these days that it is hardly surprising kids grow up thinking sex is what you do all day."

MOORE: There's an implicit truce between the sexes that they don't ask. If it's a steady relationship they don't talk about it. The boy might have a few one night stands and use condoms but there's an implicit agreement that he doesn't say.

ROSENTHAL: One of the problems here is that it's actually not possible to talk about adolescents as a homogeneous group. Comments being made about AIDS and AIDS prevention were that adolescents see themselves as invulnerable and therefore, if you can only crack that invulnerability, you can get in and do some prevention. But it is not as simple as that. Some adolescents see themselves as invulnerable, others don't.

What form does their sexual experimentation take? Is sex for instance always understood to be penetrative intercourse?

ROSENTHAL: We're usually talking about penetrative sex but one of the things that is interesting is the variety of penetrative sex that occurs. That's another thing that we really want to draw attention to: the fact that sex can be non-penetrative and still be pleasurable, as it was in my day. Experimenting with non-penetrative sex is really quite adaptive, especially for women.

MOORE: Through that experimentation women can find what pleases them. Heavy petting still occurs but now there is much more pressure, once they get to a certain point, to move straight to intercourse.

There has been a change in oral sex too. Other studies show that oral sex is more popular now among young people, probably because it's seen as a more safe alternative to penetrative sex.



PHOTO: RON ROBERTSON

Is that true, is it safer?

ROSENTHAL: Well, yes for AIDS, but certainly not for some sexually transmitted diseases.

A survey conducted by the Royal Australian College of Obstetricians and Gynaecologists indicates that at least a third of year 10 students had no idea that sexually transmitted diseases could be passed on during sex. Is sex education therefore being instigated early enough or effectively enough? Is there a case for sex education being taught in primary schools?

MOORE: We didn't look much at STDs apart from AIDS but research has shown that young people don't know much about STDs. The problem with having a program in schools which is too explicit too early is that some primary school kids and some secondary school kids are just not ready to hear it. They can be absolutely put off by it and find it absolutely disgusting. They're not thinking about having sex. But yes,

there other groups of kids who are ready to hear it.

ROSENTHAL: You can't wait until everyone is ready. You have to have some sort of program that will get across broad sorts of messages so kids will be able to take out of them what's appropriate and keep reinforcing those messages as they get older. I would hate to see sex and health education wait until secondary school. I think it's got to be done early.

Would you talk in that context about AIDS?

ROSENTHAL: I think you have to. I actually hadn't realised the extent to which kids are aware of AIDS. One of my students works with kids as young as 10 and they were

quite knowledgeable at one level. But you do it in a normalising way. That's what we mean by sex education being part of health education instead of saying, "Let's look at this thing that is really important and separate it from everything else". That would make it frightening.

MOORE: It's important not to have all your health education about disease because sex can be a really healthy, positive thing. We don't want to keep giving these messages to kids that sex is yucky because they'll know as soon as they start having sex that it isn't yucky.

But you've also got to forewarn them that there are dangers.

MOORE: Part of it is teaching kids good decision-making skills. When they're going to choose a behavior, what should they do first, before they make that choice?

Are there any indications that kids are relating the risks of AIDS to themselves?

ROSENTHAL: There has been a

"If you've got a mum who brings a different boyfriend home every night of the week, that's telling you something about the nature of sexuality."

behavior change in the sense that more kids are now using condoms than they would have been 10 years ago. The condom has become an acceptable AIDS preventative. They say "OK, if you're going to have sex, you're going to have condoms". So I think there has been a real change.

But in your book you say there was an overwhelming gender bias as to who is expected to be responsible for safe sex practices. Your survey into the sexual behavior of secondary school students shows that some 80 per cent of the girls and 90 per cent of the boys believe the onus for the use of condoms was the female's responsibility.

MOORE: Kids might feel positive towards condoms, but that doesn't necessarily mean they'll use them. And whereas kids nowadays who are sexually active have probably had experience with condoms, that doesn't mean they use them every time. It's spasmodic.

ROSENTHAL: The uni students we looked at indicated that a quarter were using condoms all the time, and then another quarter were not using them. There were lots of reasons why they weren't using them that had to do with the moment: they didn't have one with them; they got carried away; they were drunk at the time; they were in a permanent relationship; the partner didn't want to use them. There's a whole range of reasons but few said they didn't like them.

In the US there is a pattern showing a significant number of HIV infections that show up in the mid-20s age group were actually contracted when they were teenagers.

ROSENTHAL: That's also the case here but they are nearly all gays. The percentage of injecting drug users is also very low in Australia relative to other countries because of the needle and syringe exchange programs.

Can we outline the risk groups in adolescents?

ROSENTHAL: No! We are really opposed to talking about risk groups, we really only talk about risk behaviors.

So what is risk behavior in the Australian context?

ROSENTHAL: Anal sex without a condom. And injecting drugs with shared needles.

Is there much evidence of injecting drug users being a source of HIV transmission in adolescence?

ROSENTHAL: Very low numbers in Australia – about four per cent.

MOORE: The real danger for Australian adolescents is that the situation could change here. The heterosexual population could get cross-infected more than it already is, so kids taking the gamble might all of a sudden find themselves losing out.

What about homosexuality in adolescence. Do we have much information on this?

MOORE: It's the other option now. It's always been a choice but not an open choice. We don't know if there are more gay teenagers today but certainly it is more openly discussed. But we have to be very careful not to typecast kids when they're still experimenting and not confirmed as gay or not. They're very fluid in their sexuality. There is support needed for young kids in adolescence who think they might be gay – they are really expressing unsureness.

But undoubtedly this is potential risk behavior. Are they showing any prudence?

ROSENTHAL: The gay community has been enormously effective in taking on safe sex but there is real concern about young gay guys. They don't attach themselves to the gay community and are not subject to the safe sex norms of

that group. So there is real concern about the behavior of young gay guys who are a hard group to get to.

Given what you know, if you were 15 or 16 year old girls in today's world, what would you do about your sexuality?

ROSENTHAL: It's a really difficult question. Hypothetically I would like to think if I didn't want to have sex I would be able to say no, and I would like to think that if I did want to have sex, it would be protected sex. But, who knows? It was hard enough in my day when the pressure against penetrative sex was incredibly strong.

Then there weren't that many girls' magazines telling you how to have an orgasm and so on. So I don't know how I'd be today.

There is such implicit pressure on young girls to be responsible. Are the boys taking any responsibility?

MOORE: Some are. We've interviewed boys who are being very responsible. We've also interviewed boys who are experimenting but only if they're safe. We've also interviewed boys who have said they'll get what they can. So once again there is a whole range and boys, I guess, need that education too. The kind of education they need is not so much that they should always be looking after their partner but that they should be looking after themselves.

Are they getting that message if, as the surveys indicate, 90 per cent of boys believe a condom is her problem?

MOORE: Some young people are having sex when they're very emotionally immature. They're having the sex but they haven't got the maturity to say, "Well we ought to be using a condom", or even to manipulate the situation so a condom is used. That's one of the ways of educating boys.

ROSENTHAL: It also hinges on broader

"We don't want to keep giving these messages to kids that sex is yucky because they'll know as soon as they start having sex that it isn't yucky."

societal expectations of girls and boys. For instance, girls are still expected to be the good ones: making sure that the interpersonal situation is flowing along nicely and taking care of the other, so that the boys can say, "Let the girls do it".

And yet this delivers the girls straight into conflict: if she appears to be prepared for sex, she must be a slut.

ROSENTHAL: Exactly. I keep quoting one of those early AIDS advertising campaigns – "If it's not on, it's not on". That put girls into a real bind by asking them to be assertive when many girls are unable to be assertive, and many boys won't allow that to happen. It's asking them to go against the norms of what is appropriate feminine behavior.

There are so many conflicting ideas and dilemmas in this picture. Sex was hard enough when the risk was pregnancy or a disease like syphilis.

MOORE: In a way the Pill made it difficult for the AIDS message to come across at first because people were saying, "Oh well, she's on the Pill so we don't need to use a condom". But I have a sense that is changing.

AIDS is the flagship for the idea that sex has more hazards to it than ever but the actual problem is STDs, which would indicate there isn't a great deal of safe sex being practised?

ROSENTHAL: AIDS has really swamped the other STDs. On the other hand, I would have to say that, prior to AIDS, STDs barely entered the consciousness of young people, so in some ways a good thing that AIDS has done is to bring sexual health into focus.

One of the ways of getting the AIDS message across is to concentrate on other STDs where the likelihood of infection is greater and where there are still, for some people, very debilitating consequences like infertility.

There are a large number of STDs – chlamydia, gonorrhea, genital herpes, genital warts, hepatitis B. They are not showing up in great numbers but if you look at the prevalence among 15 to 25 year olds they are an at-risk group. In relative terms, adolescents are more likely to get STDs than HIV.

In 1992 there was a suggestion of condom-vending machines being placed in high schools. Despite fears that this would tacitly encourage greater sexual activity, do you see this as a positive idea?

ROSENTHAL: Yes.

MOORE: It should be a decision of the school community and that community includes the kids, not just the parents and the teachers.

One of the conclusions you draw in your book is that there should be a new emphasis on sensuality rather than sexuality? Can you explain what the difference is and how can you see this being bought about?

ROSENTHAL: It's about promoting non-penetrative sex, recognising that sexuality is not just about fucking, but also touching and being close physically.

MOORE: Extending that time between hand-holding and intercourse, the way it once was.

ROSENTHAL: It's about giving kids permission to say, "That's as far as I want to go and I'm finding this perfectly satisfying sensually." For a lot of kids, actual fucking is very unsatisfactory. What we're really saying is extend the options for kids. Allow more choices.

MOORE: It would be nice to see media images that reinforce those choices.

Is it safe to assume that we are living in a totally changed world as far as sexuality is concerned?

MOORE: There is change and continuity. There will always be risks to

sex. Even if the physical risks are removed, there'll be emotional risks, risks of feeling bad, feeling jealousy and pain. Sex is a risky business but it is also a pleasurable business related to being a healthy, whole human being.

ROSENTHAL: It will never be the same because we are living in an age of irrevocable change in the sense that information about sex is all over the place. It is more open and I can't imagine it will ever go back to the days when I was a kid when you didn't talk about it, nothing much was written about it, and we were truly ignorant. I had no idea that there was oral sex or anal sex when I was a teenager. Those changes are irrevocable.

Overall then are you hopeful or fearful for the kids of the new age?

ROSENTHAL: For some kids it's very tough and it has to do with other facets of their lives rather than the AIDS scare. There are a number of kids out there who are having to use sex to survive and that's terrible. And I think too, for many kids, one would be hopeful. Life for them is not all that different to the way it was when we were kids. But there are more significant risks.

So how are we doing in Australia in helping kids negotiate this new sexual reality?

MOORE: We're doing very well. Our education is a lot more open and there are more options to learn about sex and to learn about healthy behavior.

ROSENTHAL: It's a positive situation relative to what is happening elsewhere, which is not to say there are not a lot of areas where we could be doing better.

MOORE: Particularly in helping young girls be more assertive. ★

• *Sexuality in Adolescence* by Susan Moore and Doreen Rosenthal, Routledge, London 1994.

Revealed: how the glossies do it!

Women's magazines are full of sex and sexual advice aimed at putting today's woman on top. But do teenage girls understand that the messages don't tell the whole story?

YOUNG WOMEN LEAFING through the January edition of *Cleo* magazine could hardly fail to notice a two-page color spread of close-up shots of male genitals.

The reason for these full-page full-frontals was ostensibly an article on male circumcision which posed the question, "Is sex better when he's circumcised?" A accompanying list of reasons for and against tells the reader that "a foreskin gives you more to play with when you have oral sex" and "it's easier to masturbate a man with a foreskin". An unnamed woman claimed she felt "much closer physically" to her partner since he'd been circumcised "because it feels like there's nothing between me and his penis".

Each month teenage girls provide a willing and accepting readership for Australian mass-market magazines containing articles such as "How to be fabulous at fellatio", "Masturbation – How to do it", "I had sex with more than 100 men", "Sexual Toys and Treats", "Go Ahead and Have A One Night Stand" and "Celebrate! You can Orgasm faster than a man".

Advice for readers includes tips on inserting marbles called "love balls" into the vagina ("they create novel sensations and some women have been known to wear their Love Balls while shopping or at work"), and having sex with a blow-up doll.

These women's magazines are something of an oddity. They have no obvious parallel in men's magazines; they are not generally considered pornographic yet contain a high proportion of sensationalised and sexually explicit material; and they are bought widely by teenagers, many of whom have had little experience of sexual intimacy.

It would be foolish for parents and

teachers to think no one reads them. In Australia, women's lifestyle magazines like *Cleo* and *Cosmopolitan* attract over \$2 billion a year in advertising for cosmetics, lingerie, perfume and clothing. Circulation figures for each

editorial, *Cleo* editor Lisa Wilkinson proudly claimed the magazine was the first to provide Australian women with information about "the real nitty, gritty stuff of their lives". In the same issue, an introduction to "Cleo's Best Ever Sex



magazine is estimated at 250,000 and climbing.

So what interests do they satisfy and what effect do they have on teenage women and girls? When 21C interviewed a sample group of teenage girls, all said they read *Cleo* and *Cosmopolitan*, chiefly for fashion and beauty hints or information on dieting. Some thought the sexually explicit material "daggy and old fashioned" but the majority admitted to reading it. "You've got to know what to do when a man asks you out," said one girl. "You've have to be good at sex or they'll dump you and find someone who's better."

The editors of *Cleo* and *Cosmopolitan* declined to be interviewed for this article and did not respond to a list of questions faxed to their respective Sydney offices. However, in a recent

Tips" boasts "we were the first to bring you sex upfront and in intimate detail... Over the past two decades we've been putting women on top and in control of their own sexuality..."

It's a claim that educational theorist and sociologist Dr Jane Kenway dismisses as uninformed and irresponsible. Dr Kenway, associate professor of education at Deakin University in Victoria and co-director of Deakin's Centre for Education and Change, claims women's magazines like *Cleo* and *Cosmopolitan* are turning sex into a consumer commodity and exaggerating adolescent fears about sexual inadequacy.

"They are telling adolescent girls that here is yet another area of life where you have the potential to be a miserable failure. Sex is not presented

"They are telling adolescent girls that here is yet another area of life where you have the potential to be a miserable failure... Young girls think that if they are not having sex then there is something wrong with them."

as a normal aspect of human relationships but as a set of complex techniques to be mastered. The female body is presented as a surface to be manipulated for sexual pleasure – a sexual instrument.

"These magazines don't prepare young women for the inevitable emotional or psychological realities of sexual relationships. They emphasise sexual performance rather than

they are emotionally equipped to cope with such information.

The psychologist (who doesn't wish to be named for reasons of professional confidentiality) says articles on topics such as oral sex, masturbation and the best sexual positions to stimulate vaginal orgasms create "a potentially damaging climate of anxiety and fear" among adolescent girls.

"The impact of this sort of material

"I have counselled distraught girls who were sexually assaulted or came close to being raped because they misread a situation entirely," says the psychologist.

IN AUSTRALIA AND OVERSEAS, surveys of women have repeatedly shown that a majority are dissatisfied with their body shape and image. Many women's magazines in Europe are seeking to address the issue by using older or larger-framed models for fashion shoots, placing greater emphasis on physical fitness as opposed to diet and devising fashion features that use 'ordinary' people with a wider range of female body shapes and sizes.

In contrast, Australian women's magazines appear to play upon readers' fears about the unacceptable shape, size and smell of their bodies.

Cosmetic surgery is suggested for one woman who complains that her labia major "hangs out" and she feels self-conscious "because boyfriends invariably comment on it".

Another writes that her boyfriend says her nipples "taste like onions and he can't bear the taste of this in his mouth". The reply seriously recommends she exclude chives, shallots, spring onions, leeks and garlic from her diet.

Dr Kenway says such information is not educative, but simply exaggerates the fears of adolescent girls regarding the acceptability of the average female body.

"These articles are not seriously informing young women about real health issues. They are about obsessively preparing your body for the sexual enjoyment or critical appraisal of others. The female body is not presented as something to celebrate but a thing to be manipulated and controlled through dieting, cosmetics and cosmetic surgery.

"The body becomes a focus for fear and self-loathing." ★



intimacy or responsibility in relationships and create excessive, unrealistic expectations about sex.

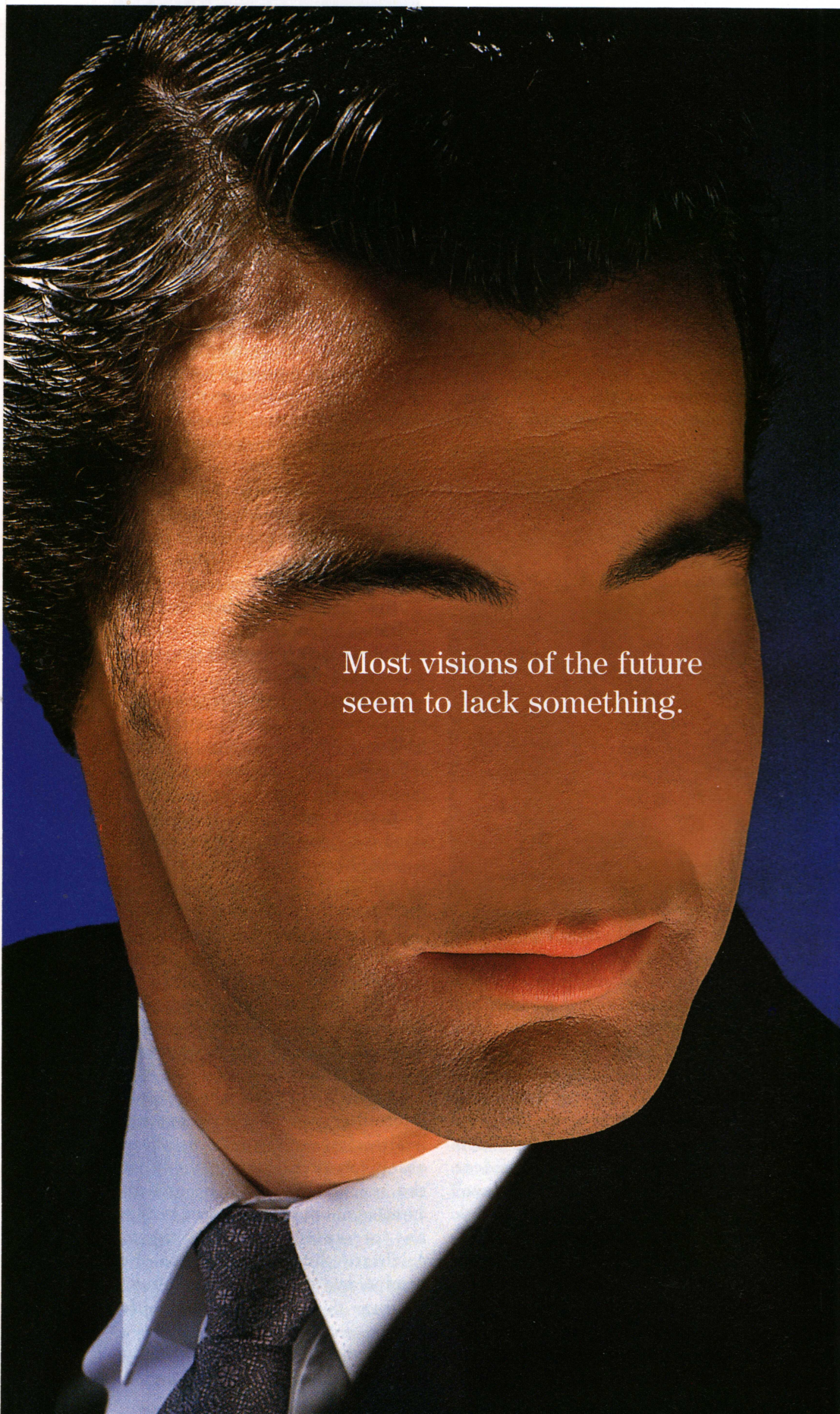
"Young women are urged to develop a repertoire of sexual tricks and good sex is seen as one of the highest forms of achievement possible for a woman."

Dr Kenway believes this emphasis on sex is creating a regressive image of women as passive pleasure seekers with little interest in social or political issues and a poor grasp of community responsibility. Women are presented as being sexually – rather than politically or socially – active.

Kenway is not alone in her views. A psychologist who works with adolescent girls in Melbourne's inner suburbs claims women's magazines are making sexually explicit material available to young women well before

is to pressurise natural sexual development and create a premature developmental crisis. It pre-empt the natural process of sexual discovery and young girls think that if they are not having sex then there is something wrong with them."

The magazines also mislead girls about the nature of sexual cues and sexually acceptable behavior. Although the magazines may claim "men fantasise about sexually confident women who make the first move" (*Cleo*, August '93, "Do Nice Girls Ask for Sex?"), the social and physical reality may be quite different. Young girls can learn, often in unhappy and emotionally disturbing circumstances, that male behavior may not match the image of the fun-loving sexy guy in the glossy magazines.



Most visions of the future
seem to lack something.

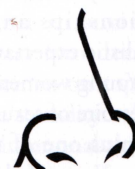
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Outguessing the aliens


PHOTO: CSIRO DIVISION OF RADIO PHYSICS

David G. Blair

On October 12, 1992, NASA inaugurated its Project Columbus: Search for Extraterrestrial Intelligence (SETI). One year later the US Congress cancelled it, saying that "it is not in the business of funding science fiction". Within a month of cancellation several million dollars in donations from the general public demonstrated that numerous people disagree. The project is going ahead, under the auspices of the SETI Institute in California. In 1995, I hope to be part of the team (led by the CSIRO's Australia Telescope division) conducting the first full scale search, using the Parkes radio telescope.

But where in the galaxy and its 10^{10} radio frequencies will we look? The intelligent way to narrow our search is to guess how an alien civilisation would go about trying to find

and communicate with us.

Imagine you are a member of an old technological civilisation about 100 million light years away from Earth. You have advanced astronomy and are able to identify solar systems within the nearest few hundred light years. Using very high resolution infrared and microwave observations you can identify planets with oxygen-nitrogen-water- CO_2 atmospheres. Perhaps you can even identify chlorophyll lines.

Through such observations you can identify life-bearing planets. Perhaps by combined studies of each planet's atmosphere and the central star you might be able to pin down its stage of evolution to within 10–100 million years – the exterior appearance of a planet changes very little over its evolutionary history.

If your astronomy is good and you watch for long enough, you might be able to

identify a point when a sudden CO_2 build-up indicates the onset of an industrial revolution. But since this has gradual beginnings, and since initially it does not change the CO_2 levels any more than ice ages and volcanic eruptions, this is probably a very poor indicator.

The only sure fire indicator of technological civilisations is the emission of radio signals. Within a few decades, if the Earth is typical, leakage of radio emissions rises to about 1 megawatts (MW), and increase to well over 10 MW within a century.

What sort of antenna would you need to pick up such emissions at a distance of 100 light years? For a power of 1 MW at 100 megahertz (MHz) (television frequency) the signal would amount to about 1 photon per 10^6 m^2 per second. But galactic synchrotron radiation

Parkes radio telescope, NSW. The first full scale search for extra terrestrial intelligence will be conducted in 1995 using the Parkes facilities.

noise contributes 1000 times more noise than the one photon quantum limit at this frequency. At short wave radio frequencies it is even worse. To detect leakage from the Earth, you would need antenna of roughly 10^9 square metres (m^2), say 40 km diameter. This collection area would need to be distributed over a large enough baseline to obtain enough angular resolution to discern this radio leakage over the galactic noise. So, for a practical monitoring system you might set up several orbiting 40km diameter dishes, spaced many millions of kilometres apart.

You would not want to monitor only one target planet. That way you might have



PHOTO: CSIRO DIVISION OF RADIO PHYSICS

Looking for aliens involves serious astronomy: the control room at Parkes.

to wait 100 million years for results. You would maximise your chances by scanning as many solar systems as possible – say 10,000. Then if you had done your astronomy well enough, and could predict the onset of technology to within 10 million years, you might, on average, detect the emerging radio emission from a new civilisation once every 100 years.

Once you detected radio emissions, the next task would be to direct a beacon signal to the source. Knowing that the emissions you detected were broadcast around 100 years ago and that your beacon will not be received for another 100 years, you might reasonably hope that by the time the beacon arrived, the target civilisation will have invented radio astronomy and be on the look-out for beacons. The beacon is easy to send. You already have big dishes and you know where to send it. Just a few kilowatts will be

easily seen by the future radio telescopes of your new-found civilisation.

But how do you choose the beacon frequency? I once met a man from Costa Rica who had arranged to meet a friend in Paris. They agreed on the date but unfortunately they forgot to arrange a meeting place. They were both travelling and there was no way of communicating. No problem. They both asked themselves: what is the logical meeting place? They both picked the Eiffel Tower, and sure enough they met.

You might assume that an alien civilisation listening for messages from space would employ similar logic – otherwise there are roughly 10^{10} radio frequencies to choose from (assuming a 1 Hz bandwidth) as well as 10^8 different directions (determined by your telescope bandwidth). The aliens you are trying to contact have no idea where you are –

they don't know where to point their telescopes – so you might as well make the frequency choice easy. How? You know that your frequency scale is an arbitrary historical accident, as is your decimal (or octal or whatever) number system. Natural frequencies are better choices and you immediately recognise the neutral hydrogen line at 1.4 GHz as an excellent base frequency. You also know that it is highly contaminated by hydrogen in the galaxy. So you choose the frequency as a base but realise that it must be shifted by multiplication or division – an operation which does not change the units, only the magnitude.

Your choice of frequency is further guided by a principle that has enabled your civilisation's long-term survival – the avoidance of waste. You recognise that there is a minimum energy band between 1–20 GHz where communication uses least energy. So you

choose a logical frequency in this band, based on the starting frequency of hydrogen, f_H . You might choose the simplest transformation of f_H and broadcast on $2f_H$. You might transform f_H by multiplying it by a natural irrational number which is a signature of civilisations. The most popular choices made by humans are π and e (e is Euler's number used in exponentials). These numbers are essential to communications theory. So you would broadcast the frequencies $\pi \cdot f_H$, $2\pi \cdot f_H$ and $e \cdot f_H$. Thus you define a few interstellar contact channel frequencies that seem to be good choices for beacons.

All this assumes that your astronomy is good enough to pick a planet at the right moment, and that you are patient enough to conduct a long term search. If you have less patience and the capacity and willingness to devote mindboggling amounts of energy to the exercise, you might continuously transmit an omnidirectional beacon. This scatter gun approach requires less skill in astronomy. You simply broadcast and wait for a reply. The problem is that if young civilisations are to detect this signal it must be very powerful. To be detectable by a moderate sized telescope, say 10 m diameter you must broadcast perhaps 10^{14} watts of power – all the power of 100,000 large Earth power stations, far more than Earth's total electric energy supply – continuously for at least several hundred years. If you broadcast a powerful beacon you must also consider the problem of receiving. You won't be able to detect a reply on the same frequency that you broadcast on. It would be like trying to hear a whisper while screaming your head off.

But let's say you have what it takes to get the beacon to its potential audience and to hear an answer, what and how are you going to communicate? You must devise a coding system. This you might do in the manner Carl Sagan proposes in his novel *Contact*. You arrange the beacon in three levels. The first is a very powerful beep-beep. The second: subtle changes in beep spacing, say, where a bigger gap means a '1' and a smaller gap means a '0'. The third: small changes in polarisation perhaps, happening much more rapidly so as to be able to convey much more information.

The first signal says: "Wake up, we're here". The second in binary code could teach a mathematical language and provide rules for deciphering the third signal. It could also specify the reply frequency. The third signal might be an encyclopedia.

If aliens are using advanced astronomy to look for us, and are dependent on radio signals to know we have reached the radio communicating phase, they probably still have not received our first emissions, as our expanding radio sphere is only 50 odd light years across and has only encompassed about 500 stars so far. Unless civilisations are far more prolific than we imagine, it will be at least 50-100 years before we can expect a reply.

Alternatively if they are sending omnidirectional beacons, the signals would be there now, awaiting detection.

Recently radio astronomers discovered extraordinarily powerful radio signals at a frequency of 6.668 gigahertz (GHz) coming from the methanol masers in star forming regions of our galaxy.

These are among the brightest radio sources in the sky. Yet they have been overlooked for 20 years, because nobody looked in the right direction at the right frequency. Powerful beacons could be illuminating the Earth, and we may be missing them.

NASA's Project Columbus sky survey should settle this point, although it won't be sensitive enough to detect weaker beacons.

Unfortunately NASA's targeted search, which will be much more sensitive, won't be covering most of the interesting beacon frequencies – namely 3.86 GHz, 4.46 GHz and 8.92 GHz (e.f.H, π .f.H, and 2π .f.H).

It is hard to imagine any reason why extraterrestrials would broadcast the enormous power levels necessary except as beacons. It is therefore hard to suppose that these frequencies will be chosen arbitrarily. Anybody engaging in such a prodigious exercise will give great care to choosing the rendezvous point. On Earth we should do likewise.

In 1995, the SETI Institute's first full-scale search will be conducted using the Parkes radio telescope. This was been the site of the first search at π .f.H in 1990 and 1991 by a CSIRO-University team. With NASA, the SETI Institute has developed superb spectrum analysis equipment which can examine enormous chunks of the radio spectrum simultaneously. As a part of the CSIRO-SETI institute agreement, Australians will be given access to the equipment for a few weeks. In this time we intend to cover as many as possible of the hypothesised interstellar contact channel frequencies omitted in NASA's search. ★

Shouldering the heart's burden

The only cure for a failing heart muscle used to be strong stimulants or transplant surgery. Now researchers at the Childrens' Medical Research Centre in Sydney are working on an alternative treatment that involves relocating shoulder muscle and wrapping it round the heart. The strong shoulder muscle is then retrained to behave like the heart's own contracting muscle, helping it to pump blood around the body. The procedure has already significantly prolonged the life of one Australian patient.

Bees busy in rainforest

University of Queensland researchers are studying the impact of the European bee (*Apis mellifera*) on native rainforest plants and animals. An increasing number of commercial apiaries operate in or near rainforest and it is thought that by competing with native collectors of pollen and nectar, honey bees may have negative impacts. Pollen collected by bees is studied microscopically to identify source species.

New Mars probe

NASA plans to launch another probe to Mars on 3 November, 1996, if Congress approves President Clinton's 1995 federal budget. The budget includes a \$77 million allocation for Mars Surveyor, a scaled-down version of the \$980 million Mars Observer. NASA lost contact with Mars Observer on 21 August 1993, just days before it was to enter Mars

orbit. NASA has decided against re-using General Electric's Mars Observer spacecraft design. NASA is looking for a new contractor, which it hopes to name by July. The new contractor will have only two years to design, build and test a new spacecraft.

Galileo spacecraft detects asteroid's moon

NASA's Galileo spacecraft observed what is probably a natural satellite of the asteroid Ida – which would be the first moon of an asteroid ever sighted – during the spacecraft's flyby of Ida last August. The object is revealed in data samples now being transmitted by the spacecraft and analysed by scientists at NASA's Jet Propulsion Laboratory in California. Galileo has completed nearly 90 percent of its 3.8 billion kilometre journey to Jupiter. Galileo will go into orbit around the giant planet after exploring the atmosphere with an instrumented probe on 7 December, 1995.

Re-burnable building

Test results from a new Victoria University of Technology Experimental Building-Fire Facility will play a key role in the research necessary for a national fire safety code, according to Professor Vaughan Beck of the institution's Centre for Safety and Risk Engineering. The multi-million dollar structure, designed to be reused after successive test burns, will enable researchers to look at the complex interactions which take place in a fire. ★

New national science curriculum

David Eyre

This year, Australia may move closer to adopting a national curriculum for science. Jointly developed by the Commonwealth, States and Territories, new curriculum documents, *Statement on Science for Australian Schools* and *Science Profile* will be used by teachers across Australia in 1994. The extent of implementation, however, at this stage remains unclear.

A primary objective of the new curriculum is to reduce students' 'deadtime' – time when individual students make no progress because they are too far behind or ahead, or simply need to find out about a different aspect of a problem than is being addressed by the class. It also provides an agreed set of outcomes for students in grades 1-10, a common language and framework across States and schools, and continuity between primary and secondary education.

Cliff Malcolm of the Curriculum Corporation, the national organisation which co-ordinated production of the materials, says that the new curriculum addresses the limitations that conventional assessment places on science teaching.

"Traditional science teaching rests on the principle: 'At the end of this lesson, every student will be able to demonstrate X'. Objectives written this way prescribe what teachers do – inputs – and what students learn – outcomes. The inputs define the outcomes and vice versa. But some students know X before they even start.

"The new approach begins from a different position: no student during a lesson should be marking time or left out.

Figure 1. A student's profile is a summary showing the current level of achievement in all strands and substrands.

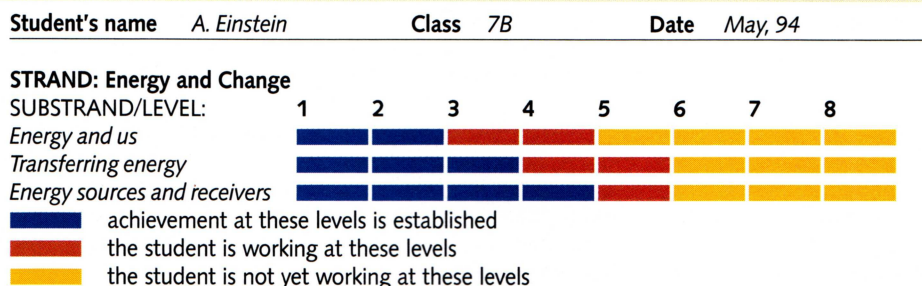


Figure 2. Outcomes within each substrand are at 8 levels of achievement, spanning years 1 to 10. Most students will reach about level 6 by the end of Year 10. Each substrand is based on a proposition or 'unifying idea' that students understand in increasingly sophisticated ways as they progress through the levels.

STRAND:	Natural and processed materials
SUBSTRAND:	Structure and Properties.
UNIFYING IDEA:	The substructure of materials determine their behavior and properties
OUTCOMES:	The student ...
LEVEL 1	identifies properties of materials discernible by the senses
LEVEL 2	describes the substructure of some common materials
LEVEL 3	makes connections between the structure of common materials and their properties
LEVEL 4	uses models of the substructure of materials to explain their properties and behavior
LEVEL 5	uses simple models of atoms to explain chemical reactions
LEVEL 6	relates the physical and chemical properties to underlying structure within families of chemicals
LEVEL 7	identifies landmarks in the identification of elements and patterns in their structure and properties
LEVEL 8	reports on ways scientists have applied their understanding of the substructure of molecules to alter their properties

Classroom activities therefore have to enable different outcomes for different students: the 'input' does not define the outcomes. Teachers already know how to teach this way. The new curriculum permits them to assess this way."

The Science Profile provides a matrix of educational outcomes, arranged in strands stretching up through school and levels of achievement. Teachers judge a student's level in each strand, and plot a 'profile' (Figure 1). The profile is a snapshot of the student's current achievement level. By comparing it with an earlier one, the profile indicates progress. Malcolm says there

is no assumption, or even hope, that all students will achieve the same outcome from a particular activity.

"Suppose students in Grade 5 are studying the way a material's structure affects its properties. Students might experiment with mud bricks, re-enforcing them with straw, stones and paper. Different students work in different ways, starting from different points. Teachers observe, teach, challenge, explain, assess. This student is at level 2, that one at level 3."

Malcolm says that teachers and students have to be clear in each strand about what actually progresses as

the student learns. In the case of the strand, Natural and processed materials (Figure 2), it is the student's understanding of propositions like 'The substructure of materials determines their behavior and properties'. The traditional style is 'at level 5 students understand that matter is made of atoms'. By contrast, the Science Profile's proposition is open ended and continuous. "Post-doctoral students in nuclear physics can be working on it just as surely as children in grade 4. And achievement at any level is immediately useful to the student, not just a step towards higher levels," he says. ★

Potential anti-cancer compounds in algae

US scientists have discovered a potent new anti-cancer compound, dubbed 'curacin A', extracted from a tropical marine algae.

Discoverer of the compound, Professor William Gerwick of Oregon State University, says the extract is extraordinarily potent and is as toxic to cancer cells as several of the best known vinca alkaloid anti-cancer agents commonly used in chemotherapy. The compound is currently being tested to determine its efficacy against breast cancer, colon cancer and other cancers.

Preliminary tests show that curacin A works by inhibiting the growth of cancer cells. The compound also acts as an anti-inflammatory and immunosuppression agent, which may be useful in treating multiple sclerosis and other diseases.

The new compound was discovered in oils extracted from a microalga, *Lyngbya majuscula*, collected near the island of Curacao off Venezuela.

"It doesn't look like much," Gerwick says. "The best description is long, stringy hair – actually, it looks like the mat of stuff you might pull out of the shower drain in the morning. It's the type of thing that you'd try to get rid of if you ran a hotel on the island, thinking it would be unpleasant to the tourists. That's kind of scary to think about."

The researchers began running some assays to screen the samples for potential anti-cancer agents. With some 200 different types of cancer, and a variety of underlying causes, it isn't unusual to find a compound which has some effect against certain cancer cells.

But what the researchers found stunned them.

"As part of our screening,

we detected activity in one extract that was really phenomenal," Gerwick said. "We got not just toxicity but unbelievably potent toxicity that I had never seen before. It takes only a very tiny amount of the compound to kill a cell – around one part in a billion."

Gerwick and his colleagues have brought samples of *Lyngbya majuscula* back to his laboratory, where they are trying to grow it, do further analysis of the curacin A compound, and find out how it works. Gerwick said he hopes they can either grow the algae

through aquaculture techniques or duplicate the chemical compound of curacin A synthetically.

"I'm not a proponent of harvesting natural stands of the algae for use because it depletes the natural resource. We want to disturb it as little as possible, take a few samples into the lab, and see if we can mine the discovery, not the resource."

It may not be easy. Samples of *Lyngbya majuscula* from other sites, including Hawaii and Okinawa, contained no curacin A. Even in

Curacao, the *Lyngbya majuscula* wasn't uniform; samples from only two of several sites around the island had the compound. One site was directly offshore from an iguana-raising farm, the other was among mangrove roots in an estuarine bay.

"It may be a result of accumulation of nutrients," Gerwick said. "There is so much we don't yet know. But our initial findings are tremendously exciting and point out the global importance of protecting biodiversity." – OSU News ★

Tracking the albatross

A multi-disciplinary team of Australian scientists and volunteer naturalists is tracking albatrosses by satellite using back-pack transmitters glued and taped to the birds' feathers. Besides collecting location data essential to conservation of the species, the team hopes to prove that albatrosses hitch rides on winds on the edges of high and low pressure systems as they journey some 15,000 kilometres from Australia's south-east coast to their breeding grounds in the Crozet Islands between Antarctica and South Africa.

Four of the birds were fitted for transmission in 1992. Two of these were successfully tracked to the region of the Crozet islands, one actually to the island where its transmitter was pinpointed and recovered near a nest. When records of the birds' flight paths were superimposed on Bureau of Meteorology records of Indian Ocean weather patterns it was found that the birds appeared to be following the pressure systems – clockwise around the lows and anti-clockwise around the highs.



PHOTO: DAVID NICHOLLS

Janice Jenkins of the NSW Albatross study group with an albatross about to be fitted with a back-pack transmitter. It is thought that the giant birds, whose wings may span three metres or more, ride the high winds circulating at the edges of weather systems.

Larrobe University space physicist Dr Eric Butcher, said that this year small barometers will be placed on the transmitter package so that more precise values of air pressure can

be collected – effectively making the birds mobile weather stations. Also, small motion switches will provide data as to whether the bird is flying, feeding, or just sitting on the water.★

Russian launch site planned for PNG

Jon Fairall

Late in 1993 officials of Space Transportations System (STS), a Brisbane company, signed a protocol with Russian officials to begin working on a rocket launching site in Papua New Guinea. The protocol has received little attention in the popular media either here and overseas, yet it may prove to become one of the defining documents of a whole new market – lifting really heavy loads above the Earth's atmosphere.

The business of lifting satellites to geostationary orbit is the preserve of less than half a dozen organisations: Ariane in Europe, General Dynamics in the US, China's Great Wall Company, the Japanese Space Agency and the Russian Design Bureau of General Building. Geo-stationary orbit (the satellite remains above the same point on earth) is home to most of the world's communications satellites. They usually weigh about two tonnes. The economic attractiveness of each of these competitors can be seen from the fact that Ariane currently owns over 70 per cent of all the bookings of commercial payloads over the next three years. Later this year, Ariane will strengthen its position even further with the launch of Ariane 5, which will be able to lift three typical communications satellites at a cost only marginally more than current rockets can lift one.

In deference to the US State Department, which wants to protect the market for General Dynamic's Atlas vehicle, Ariane has agreed not to drop its prices by more than 15 per cent on Ariane 5, but it seems they could, and will, do a lot better. Until now,



PHOTO: JON FAIRALL

Russian officials visiting a potential launch site for the Proton rocket in Papua New Guinea.

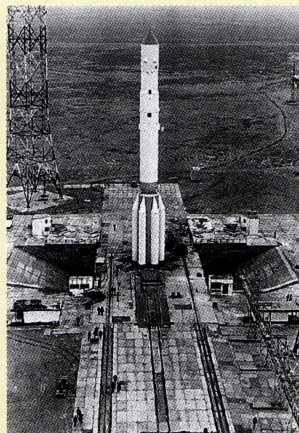
none of the other space-faring nations have indicated a desire to chase greater efficiencies in space. The US is mired in a sea of post-cold war rhetoric and confused aims, while its space budget evaporates in endless re-designs of the Space Station. For the other players, the enormous cost involved is a strong disincentive. But now the Russians have signalled that they want to play a major role in the space industry of the 21st century, their current economic fortunes notwithstanding.

The Russian space industry

is one of the few industries to have emerged from the Soviet Union with world-competitive technology, they want to use it to earn foreign exchange, and they are prepared to invest to keep it competitive. The linchpin of their plans is a launching site on the equator. Their Proton launch vehicle can lift only 2.4 tonnes to geostationary orbit from Baikonur: launched from the equator it can lift 4.8 tonnes. A new fourth stage currently under development will improve this to 7.8 tonnes – about the same payload as Ariane 5.

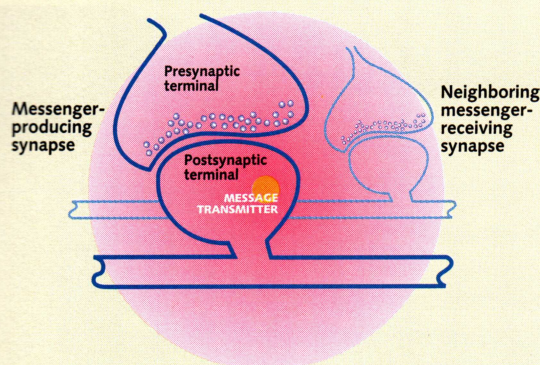
By a happy coincidence, Russia's plans dovetailed quite neatly with those of STS. The Australians had been dealing with the Russians for the best part of a decade over plans to build a launch site at Cape York. It didn't take much work to mate Russian and Australian plans to produce a PNG-based, private enterprise funded, international space port based on Russian technology. The team is investigating the potential of sites on two islands, Manus (2 degrees South), and Emirau (2.5 degrees south). Emirau (population 300) is a small coral atoll about an hours flight from Kaviang in New Ireland. Manus is at the eastern end of the Bismarck Archipelago. It is very much larger and has a population of about 30,000. Under the proposal, STS will build the launch site and its associated infrastructure, and market flights in Asia and the West. Building such a site is no small operation, and would require STS to command between half and one billion dollars. STS's final role in the business will depend very largely on how close it comes to raising this. ★

Contenders in the heavyweight payload class (L to R): the European Ariane, on the pad in French Guiana; the US Atlas blasting off from Cape Canaveral; the Russian Proton, being prepared for launch in Baikonur.



PHOTOS: THE PHOTO LIBRARY – SYDNEY

Braincells function as loud speakers



US researchers believe they have discovered a hitherto undocumented method used by brain cells to communicate with other cells nearby. Instead of depending only on direct connections to get their messages out, it looks as though brain cells can function as loudspeakers – sending out broadcasts and influencing their whole neighborhood. Until now, the major known method for transmitting messages between the nerve cells, or neurons, making up a brain was through direct connections, called synapses.

Scientists have suspected for about 15 years that brain cells could tell other cells – even without direct connections – that they had been activated, but no one had proof. The new Stanford University research (Madison & Schuman, *Science*, January 1994) shows that neurons in rats' brains can signal to other cells that they have been activated, even though they share no direct connections. The researchers believe that molecules of a diffusible chemical messenger – quite possibly nitric oxide – emanate from a branch of a nerve cell, sending signals in all directions. The closer a neighboring nerve cell receptor is to the chemical messenger's emission site, the stronger will be the signal it receives.

In the traditional view of how neurons communicate, an electric current travelling through one cell stimulates the transmission of a current in an adjacent cell by sending molecules, called neurotransmitters (e.g. adrenaline), across the synapse separating the two cells. The problem with accepting this as a neuron's only means of communication is that it fails to explain how neurons that are not next to each other manage to orchestrate the complicated manoeuvres they carry out during the brain's development and in later life. For example, as the visual cortex (which processes visual information) forms in a developing baby, neurons sharing no direct connections nevertheless 'know' to make their way through the surrounding grey matter and group together.

Gathering evidence that the cells could broadcast messages required some gruelling laboratory work for the researchers, who over the course of three years painstakingly placed microelectrodes in sections of rat brain. Their goal was to pierce two neighboring but unconnected neurons – not easy considering that with diameters of 20 microns (one-fiftieth of a millimeter), the neurons' cell bodies are too small to see with the unaided eye. ★

Just-in-time chemicals

In a move that may revolutionise the chemical industry, a US research team is developing ways to create chemicals as needed on site. The system would eliminate the need for storage and transportation of hazardous chemicals used in manufacturing, a growing concern as environmental regulations become tighter. The technology, developed jointly by US Los Alamos Laboratory and Electron Transfer Technologies, uses a charged plasma cell that forms free radicals, molecules that contain an unpaired electron. Free radicals are highly reactive so they bind with introduced compounds, creating chemicals as they are needed. The researchers hope to produce such chemicals as hydrogen peroxide, a key etchant used in the microelectronics industry.

Emergency data base

Australian emergency services are set to be dramatically improved by the introduction of centralised data bases and dispatch centres. A new Oracle-based client server system developed by Australian company ARC Systems in conjunction with CSIRO, enables real-time integration of information from multiple data sets. Map locations of police vehicles, ambulances, fire engines and emergency sites, along with potentially life-saving details such as building

floor plans with emergency exits, sprinkler systems and electrical control panels can be rapidly displayed. Telecom caller line ID technology (E000CLI) will allow display of the address and map location of incoming emergency calls, thus allowing operators to confirm addresses rather than request them from often distraught callers.

Making lupins safer

The safety image of Australia's \$200 million lupin industry is to be boosted by a simple test procedure developed by CSIRO. The test monitors the level of a toxin called phoropsin in the lupin seed. Lupin flours are increasingly being used to raise protein and fibre levels in bread and other foods but human toxicity has been a concern. The new test means that grain authorities and food manufacturers can quickly and accurately monitor the level of phoropsin, which is produced by a fungus growing on the grain.

Barking phone

A Telecom customer recently reported that both his phone and dog were malfunctioning – when ever he had an incoming call, the phone didn't ring, but his dog "barked like hell". It turned out that the phone line was shorting on a metal pipe to which the animal was chained – receiving electric shocks with each incoming call. ★

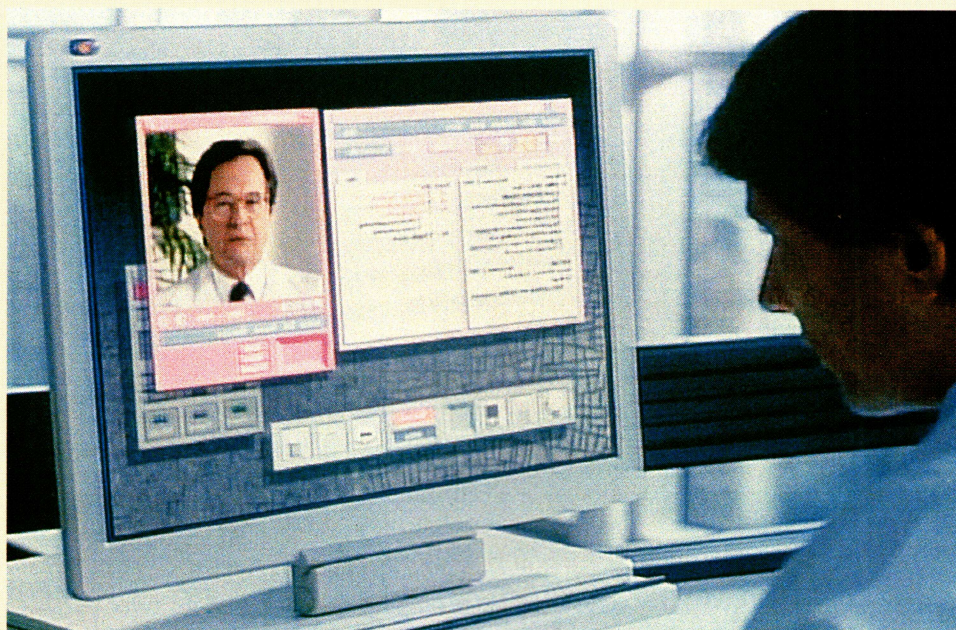
Home health care on the doorstep

Cris Popp

More home health care and rapid transfer of complex medical information are becoming a reality as Australia prepares to launch the world's first electronic national healthcare network. The Federal Department of Health claims that its Health Communication Network (HCN) will mean quicker service and better continuity of care. Scheduled for launch in March this year, it may also allow a vast reduction in paper chasing and savings of billions of dollars.

Using the phone line and fax, the HCN will electronically link doctors, researchers, hospitals, specialists and pharmacists. By enabling instantaneous transfer of complex medical information like X-rays, lab results and patient files, it will potentially extend the reach of specialist expertise to every corner of the country. When linked to bio-sensors it will enable hospital staff to remotely monitor a patient's vital signs and open the way for more health care to be shifted to the home. The HCN is expected to be self-supporting within two years through the sale of services to health professionals.

Pilot projects set up to test the HCN's potential have been successful and popular with patients and professionals alike. In outback NSW an on-going telephone radiology or 'teleradiology' project allows X-rays and brain scans to be sent from outlying areas like Tumut to Wagga Wagga and, if need be, on to Sydney. Using a video camera and PC with a high resolution monitor, images are sent via a modem down the phone line. They can be picked up at the other end on as little as a portable phone and laptop computer. Country



A medical workstation. The merging of measurement, computing and communication technologies is revolutionising the way we gather and share information. Emerging local and global networks and specialised workstations will enable doctors to easily share information anywhere, anytime.

doctors can consult neurosurgeons at Sydney's St Vincent's or Prince of Wales hospitals about the best treatment and whether it is possible, or even necessary, to move a patient with sensitive injuries, saving both lives and money. Each avoided transfer of a patient from Wagga to Sydney saves \$10,000.

There has been enormous demand to join another project for asthma sufferers linking their GP with the casualty department of the local hospital, giving staff instant access to patient files. They are then able to decide the best course of treatment, update patient details and return them to the GP. Such continuity of care is often impossible with the slow transfer of cumbersome paper documents.

Although medical technology is extremely advanced, communications between health care professionals are

not. In Australia, around 900 million paper medical documents change hands each year. Dallas Ariotti, a senior government adviser on the HCN, describes the health industry as resembling "islands – important information is put into bottles and tossed into the sea with the hope that it will be picked up by those that need it in good time". The creator of the HCN, Dr Lawrence Cromwell, says that studies have shown that 15% of all pathology results never turn up and ward nurses can spend up to 60% of their time looking for information.

Cromwell says that at its simplest, the HCN will be a directory of health care professionals and how they can be contacted. Eventually it would offer enhanced services like direct computer-to-computer links and electronic medical alert bracelets. He claims that savings will range from

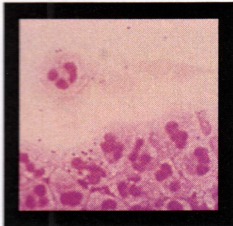
between 10 and 40 per cent of Australia's \$33 billion annual health budget.

Not everyone is convinced of the benefits though. The AMA is concerned that the HCN will dramatically increase the potential for abuses of privacy and patient confidentiality. And the Consumers Health Watch says that by allowing close monitoring of where and how money is spent, choice may be limited. The government could, for instance, restrict the right to a second or third opinion. Proponents of the HCN argue that, of itself, the system is neutral. It will not store any information but will merely facilitate its movement – a kind of electronic post office. It remains to be seen which way public opinion will swing. As the AMA's Bill McCubbery says, "I'm prepared to take a small risk with my health to protect my privacy". ★



Fairfield Hospital Melbourne

The Health Innovators



Fairfield Hospital is Australia's only infectious diseases hospital. Since its inception in 1904 it has provided leadership in the clinical management, laboratory diagnosis and research into the control and prevention of infectious diseases. Through its laboratory and clinical research programs it has made a significant contribution to the knowledge of epidemic diseases, the nature of infectious agents and more recently, antiviral agents. As a teaching institution Fairfield Hospital has been responsible for training and educating a wide range of health professionals on infectious diseases and related matters.

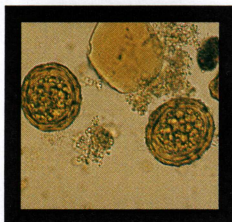
Travel medicine is one of Fairfield Hospital's acknowledged areas of expertise and a range of different services to both travellers and health professionals has been developed.

Australians love to travel and as more travel to Asia and other exotic places, many are unprepared or ignorant of the health risks they may encounter. It is estimated that at least 300,000 Australian travellers develop travel-related infections either during or after the trip, a number of which are life-threatening.

The most common illnesses experienced by travellers to tropical and developing countries are, in descending order:

- travellers diarrhoea
- hepatitis A
- malaria
- sexually transmitted diseases.
- respiratory tract infections

It is important to realise that vaccinations and medicines are only part of the prevention package available to travellers. Equally important is knowledge about appropriate behaviour to minimise the risk of infection, whilst still enjoying the broad experience and fun offered by overseas travel, and the need to seek expert medical care if specific problems arise.



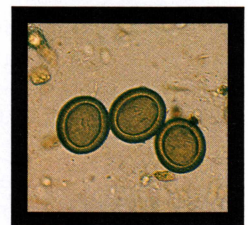
Fairfield Hospital's 0055 information line provides information to travellers regarding the travel hazards of particular destinations, and comprehensive information on the prevention of insect-borne infections such as malaria, and the avoidance and treatment of travellers diarrhoea. Travellers are able to assess from the given information whether vaccinations or special medicines will be required for their travel itinerary.



Travel medicine provides a challenge to doctors because of the detailed and up-to-date knowledge that is required both in giving preventive advice and managing illness in returned travellers. Fairfield Hospital provides a consultative service to General Practitioners for the latest information on overseas disease epidemiology, vaccines and malaria prophylaxis. Recently the Hospital's

Chief of Medicine, Dr Allen Yung, has made available to General Practitioners his "Guidelines for the Prescriber at Fairfield Hospital Travel Clinic" so that they may share the detailed travel health information given to the specialist trainees at the Hospital.

Another Fairfield Hospital innovation is its electronic library information service called FCIN (Fairfield Campus Information Network). Subscribers to this are able to access a Bulletin Board and CD ROM databases, including MEDLINE, AIDS and DRUGS, which form part of the Hospital's library services. Through a personal computer and modem, users can dial-in to a large range of health related files including Travel Medicine, HIV/AIDS, Infectious Diseases, Community Health and Waste Disposal. Although this service is already accessible from anywhere in Australia, the system will soon be launched as a Fairfield Hospital/TELECOM initiative using TELECOM's new 1-900 number service providing a cost effective means of data communication throughout Australia.



For further information about FCIN or if you wish to become a subscriber call (03) 280 2436 and speak to the Hospital's Medical Librarian Ms. Jenni Rusciano.

For travel health consultations, pre or post travel, call (03) 280 2230 to make an appointment.

For travel health advice or information on specific infectious diseases call 0055 15676 (25c/21/4sec. A. AA Premium).

Fairfield Hospital wishes all travellers a safe and enjoyable trip.

The cancer epidemic

Cancer is growing in Australia and so is death from cancer. The disease is now estimated to be responsible for more potential years of life lost than any other cause of death, including heart disease. This report – drawn from new data compiled by the Cancer Epidemiology Centre – reveals that while some forms of cancer are growing or declining in line with population and lifestyle shifts, others are rising rapidly without any apparent cause.

FUTURE HISTORIANS OF MEDICINE will almost certainly label the 20th Century as the age of the rise of cancer. At the end of the 19th, lung cancer was a rare disease; today it kills over 6000 Australians a year, due largely to the continuing impact of widespread tobacco smoking since the 1940s.

Cancer of all types is today the leading cause of death after heart disease, claiming the lives of one in four Australians. As the population ages and death from heart disease continues to decline into the 21st century, the incidence of cancer will escalate, putting a heavier and heavier burden on the nation's health system. In 1990-91 alone, deaths due to cancer in Australia cost the population over 460,000 potential years of life, a 26% rise on the annual cost 10 years ago.

Cancer control is a public health issue and, as such, depends less on the search for miracle cures, and more on better understanding the pattern and trends in the cancer epidemic during the 50 years. Only by studying how the epidemic has changed during the course of the century can we best set research priorities, minimise the causes behind the disease, and measure the success of our efforts.

What is perhaps not well appreciated by the general public is that the cancer epidemic has changed markedly since 1950, in line with changes in demography, lifestyle and medical advances. Deaths from some

forms of cancer have risen significantly and continue to do so, while others have risen and fallen, declined steadily, or remained static. Different cancers have jostled for position in the top 10 list of cancers among men and women (see Fig. 1).

Looking first at all forms of cancer (see Fig. 2), we can see that the rate of cancer deaths among women has not altered appreciably since 1950. Were it not for increasing mortality among women due to lung cancer, the overall cancer death rate in females would be decreasing. Second, we can see the increase and recent decrease in male cancer mortality has been shaped by the epidemic of deaths from respiratory cancer caused by cigarette smoking.

Some forms of cancer are increasing quickly in terms of mortality. They include melanoma, Non-Hodgkin's Lymphoma, myeloma, and cancer of the liver, soft tissues, lung, kidney and brain.

Deaths from melanoma have increased by more than threefold in males, and twofold in females since 1950-54. The annual increase has been over 6% in males and 3% in females, although female rates may be stabilising. Melanoma incidence is related to sun exposure and varies with latitude.

Figure 1 The cancer top 10

FOR WOMEN

In 1980-84:	In 1990-91:
1. Breast	1. Breast
2. Colon	2. Lung
3. Lung	3. Colon
4. Ovary	4. Ovary
5. Leukaemia	5. Brain
6. Brain	6. Leukaemia
7. Cervix	7. Pancreas
8. Pancreas	8. Cervix
9. Stomach	9. Non-Hodgkin's Lym.
10. Non-Hodgkin's Lym.	10. Melanoma

FOR MEN

In 1980-84:	In 1990-91:
1. Lung	1. Lung
2. Colon	2. Colon
3. Leukaemia	3. Prostate
4. Prostate	4. Leukaemia
5. Stomach	5. Non-Hodgkin's Lym.
6. Brain	6. Melanoma
7. Pancreas	7. Stomach
8. Melanoma	8. Pancreas
9. Non-Hodgkin's Lym.	9. Rectum
10. Rectum	10. Oesophagus

The cancers listed above are ranked in terms of annual average potential years of life lost.

Source: Anti-Cancer Council of Victoria.

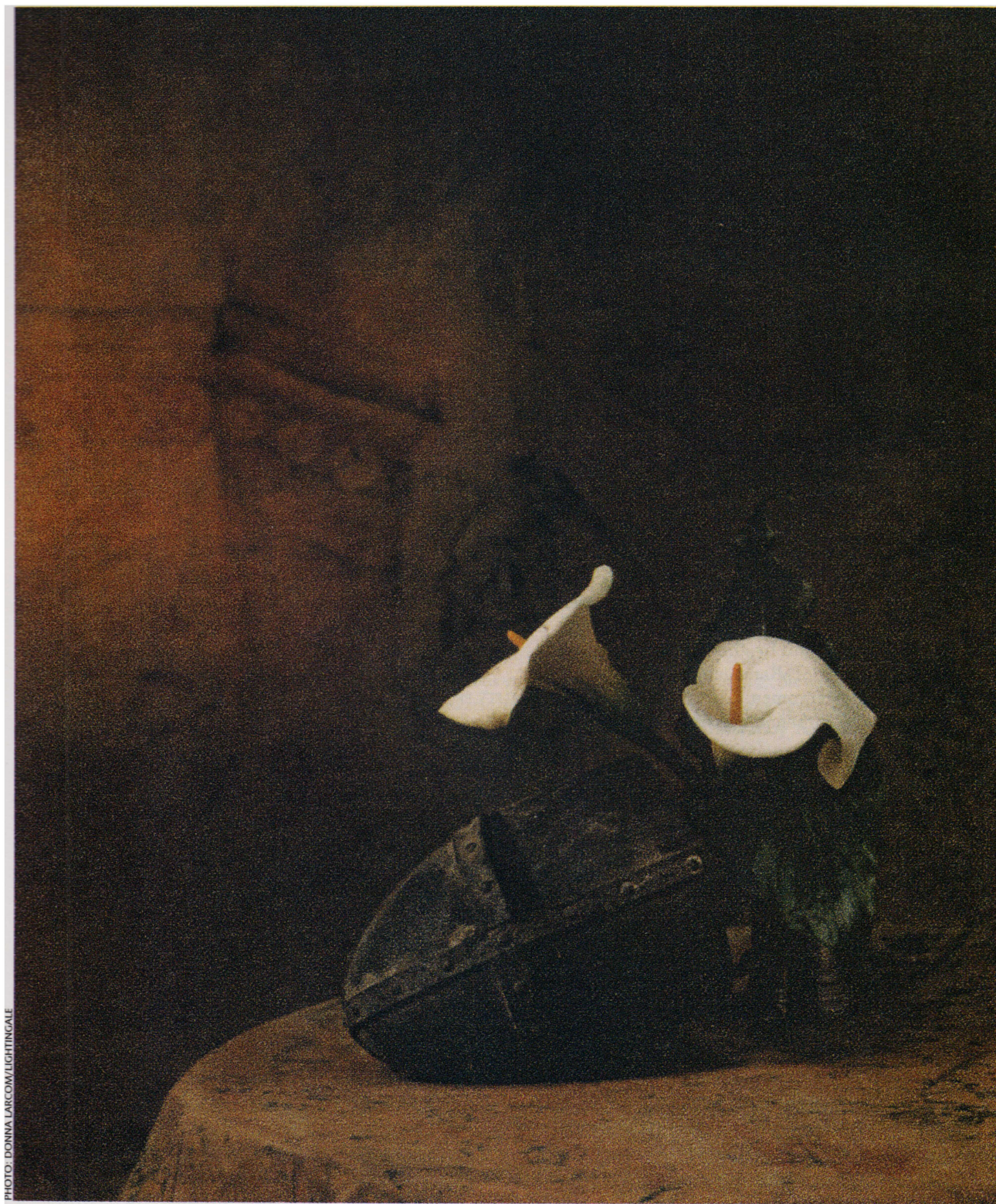


PHOTO: DONNA LARCOM/LIGHTINGALE

"Deaths due to Non-Hodgkin's Lymphoma have more than doubled since 1950 in both women and men. Unlike melanoma, there is no method of primary prevention."

Non-Hodgkin's Lymphoma (a cancer of the lymphatic system) is a particular concern. Deaths due to Non-Hodgkin's Lymphoma have more than doubled since 1950 in both women and men. The disease currently kills about 1200 Australians each year. Unlike melanoma, its causes are poorly understood and there is no method of primary prevention. Radiation and certain viral and chemical exposures are suspected to increase risk. Risk is also higher among HIV sufferers and in people given immune-depressing drugs.

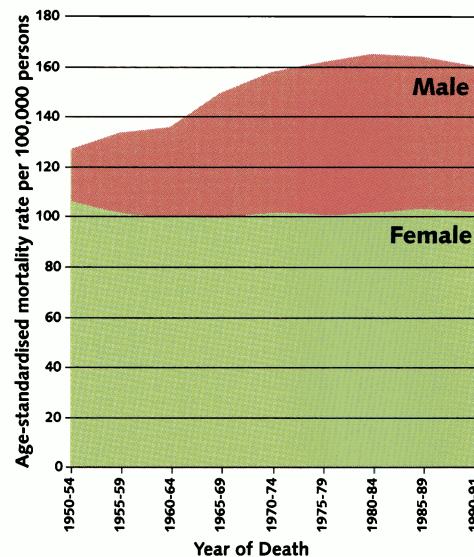
Deaths from myeloma (a cancer of the bone marrow) has increased since 1950 by 11% and 7% in males and females respectively, paralleling the trends observed in incidence. This malignancy is highly age-dependent and has been increasing as the population has aged. Little is known of its cause.

Data in regard to mortality from primary liver cancer are only reliably available since 1965. Since that time mortality rates have increased by over 5% annually in males and by almost 4% annually in females. Rates may now be stabilising in women. Liver cancer is related to chronic hepatitis and alcoholism.

Mortality from cancer of the soft and connective tissues has increased more than threefold since 1950-54, with signs of stabilising since 1980. Annual increases of 6% are observed in both sexes. The causes are not well established. Exposure to chemical herbicides has been suspected but the evidence is not compelling.

Lung cancer mortality in men peaked in the early 1980s and has subsequently dropped to the levels of 20 years ago. Although mortality in women has not declined, the rate of increase (average of 8% annually) is slowing and it can be expected to stabilise by the end of the century. The principal cause of lung cancer is tobacco smoking.

Figure 2: Australian cancer mortality 1950-1991



Deaths from cancer of the kidney are increasing by over 1% annually in males and females. The causes are poorly understood. Analgesic abuse has been implicated in Australia, especially among women. There is no method of prevention or early detection.

MORTALITY FROM CANCERS of the brain and central nervous system has been increasing since 1950 by 2 to 3% annually. The cancer currently kills about 1000 Australians a year. This trend has also been seen in other countries of a similar level of economic development to Australia and has been considered to be due to increased diagnosis, particularly in the elderly. Little is known of the causes, although dietary factors (e.g. nitrosamines in food and water) are suspected.

Rising less quickly than those mentioned above are deaths from myeloid leukaemia, and cancers of the head and neck, pancreas, and prostate.

The upward trends for death due to head and neck cancers, liver cancer, melanoma, soft tissue cancer, lung cancer, kidney cancer and Non-

Hodgkin's Lymphoma probably all reflect increases in population exposure to various carcinogenic agents including alcohol, tobacco, sunlight, and perhaps certain viruses and chemicals. The upward trend in mortality from cancer of the brain, prostate, and myeloma is partly due to increased detection and also to population ageing.

Mortality trends have been static for the last four decades for non-melanocytic skin cancer (currently the most common form of cancer in Australia), myeloid leukaemia, and cancer of the rectum, breast, bladder, ovary and male colon.

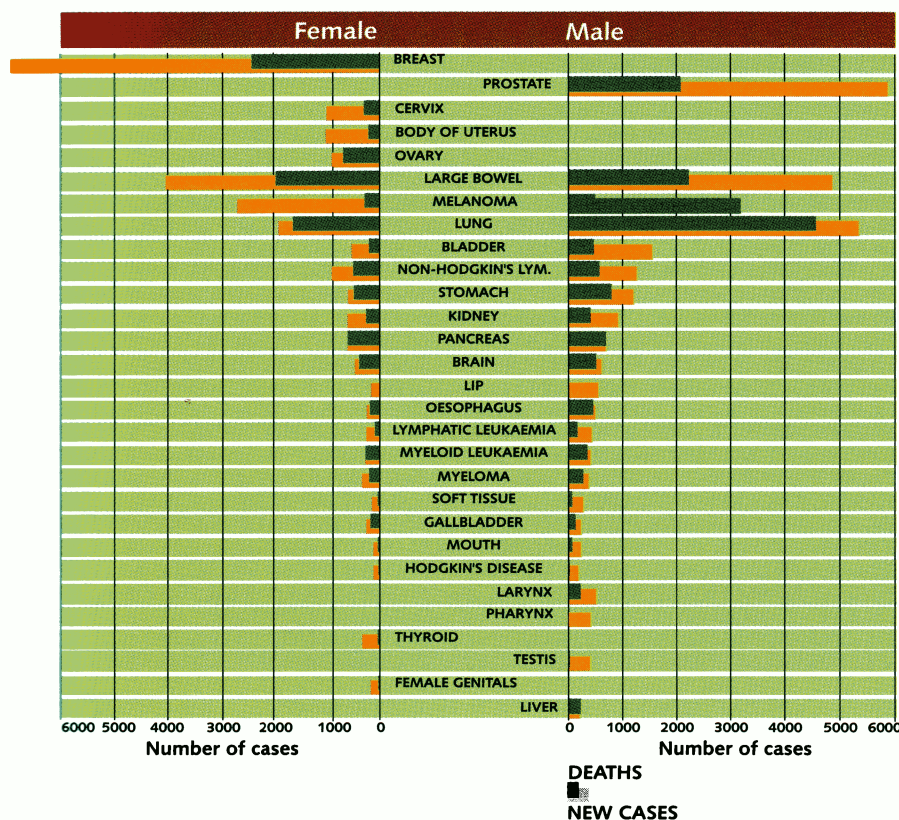
On the positive side, we are seeing strong downward trends for deaths due to Hodgkin's Disease, leukaemias other than myeloid, non-melanocytic skin cancer in women, and cancer of the lip, stomach, gallbladder, bone, testis, cervix, uterus, male and female genitals, thyroid and eye. In the most recent decade, male lung cancer also falls into this category.

Particularly pleasing is the sharp rise since the 1970s in survival rates among children suffering from cancer. In Victoria in 1970-79, more than half of the children diagnosed with cancer survived less than five years. In 1980-89, two-thirds of these children lived at least five years from the date of diagnosis. The five-year survival rate for leukaemia improved from 39% to 68% over the period, chiefly due to improvements in the use of chemotherapy. Unfortunately, survival rates for some childhood cancers (for example, neuroblastoma, which usually affects the adrenal glands) remain low.

The magnitude and direction of these mortality trends are important indicators of where and what resources are needed to increase cancer control. The first concern must be those cancers which are quickly increasing. Some of these, such as melanoma and lung cancer, are preventable through behavioral change. On the other hand,

"In 1990-91 alone, deaths due to cancer in Australia cost the population over 460,000 potential years of life, a 26% rise on the annual cost 10 years ago."

Figure 3: Cancer incidence by site (Australia 1990)



we are ignorant of the causes of soft tissue sarcoma or Non-Hodgkin's Lymphoma and cannot start to prevent their upward trend without more research. Meanwhile, it would be sensible to make an assessment of the quality of treatment for patients with these malignancies.

A second concern is that group of cancers for which mortality is increasing more slowly, such as cancers of the head and neck. Head and neck cancer mortality is increasing in the face of declining smoking rates. This is not unique to Australia and possibly reflects increased exposure to agents such as alcohol. These cancers are obvious targets for further research into prevention. Cancers of the oral cavity, for example, are potentially accessible to opportunistic screening by the dental profession.

Third, we should not be

complacent about mortality rates that are either static or decreasing only slowly – for example, common cancers of the breast, bowel, pancreas, ovary and prostate. Surveys conducted in Victoria provide some evidence that the findings from clinical trials are not being promulgated in clinical practice as widely as might be expected.

Lastly, there is the issue of early detection programs. The falling trend seen in mortality due to cancer of the cervix is encouraging. The Pap smear that was introduced to Australia in 1965 without an organised program has reduced the mortality rate to half of its original level. We can expect to see similar results in the longer term for breast cancer. Regrettably, there are no efficacious screening methods in use for many other common cancers, although we might be close to being able to screen for bowel cancer. However, as new develop-

ments in screening emerge they will need to be assessed, not only for their acceptability to the Australian public and their cost, but also for their ability to reduce mortality.

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Genes, dreams and vaccines

Cancer is not a simple disease. It is a set of perturbations in the hormonal systems controlling the production and death of cells. The best hopes of defeating the disease appear to be in genetics – better understanding the genetic mutations behind cancer, developing new gene tests for early detection, and designing new gene tools which selectively kill or confound cancer cells.

CANCER IS AS OLD AS THE FIRST forms of life – invading the bodies of dogs, birds, turtles and even yeast. It is a disease which arises because we are living biological systems and not simply blocks of concrete or machines. If treatment is to be improved, it is important that we understand the nature of cancer.

Imagine you were living 5,000 years ago and you came across a piano with no strings. How would you begin to understand piano music? Twenty years ago, cancer scientists were in the same position – they could see cancer cells, but they had no idea what was wrong with them. Why did these cells keep on reproducing themselves? Why did these cells invade and grow in different organs of the body? Why did the cells kill people through wasting syndromes?

Whilst there are many forms of cancer, the genetic mistakes which occur can be quite similar. Geneticists have put strings into the piano and are now learning to play the music, identifying the genes which control cell production and the turnover of cells in each of our organs. We are still finding out how these genes work and what has gone wrong with them in cancer.

Our bodies produce tens of millions of cells every second. Normally these cells function for a specific time in a given tissue and die. Cancer occurs when either cell production or death is perturbed. Fortunately we have several 'fail-safe' systems which operate to pre-empt the effects of potentially

cancerous mutations. Usually these fail-safe systems eliminate precancerous cells, so for year after year our bodies produce a small number of potentially cancerous cells and these are eliminated by the body's own defences. Occasionally, once every 40 years or so, a precancerous cell will develop a second genetic change, allowing the cells to replicate uncontrollably. This is cancer. We know the nature of many of

these cancerous mutations, but we have not yet learned how to control their effects.

The revolution in molecular biology has provided the tools for developing new approaches to the prevention and treatment of cancer. If used carefully, these new tools will help to lower cancer suffering and death.

Unlike polio or influenza, cancer is not a 'simple' disease – it is a set of different diseases in every organ of our bodies. Indeed, it is the hormonal systems and hormonal response systems specific to each organ which are usually perturbed in cancer. While some genes may have a major influence on the development of cancer, many other mutations are specific to stages in the production of cells in particular tissues. We have to identify these cancerous changes and, if possible, reverse their effects.

Why do cancerous mutations occur? Simply put: if you were responsible for producing hundreds of millions of genes every day, would you be right all of the time? While there are biological checks, very occasionally a

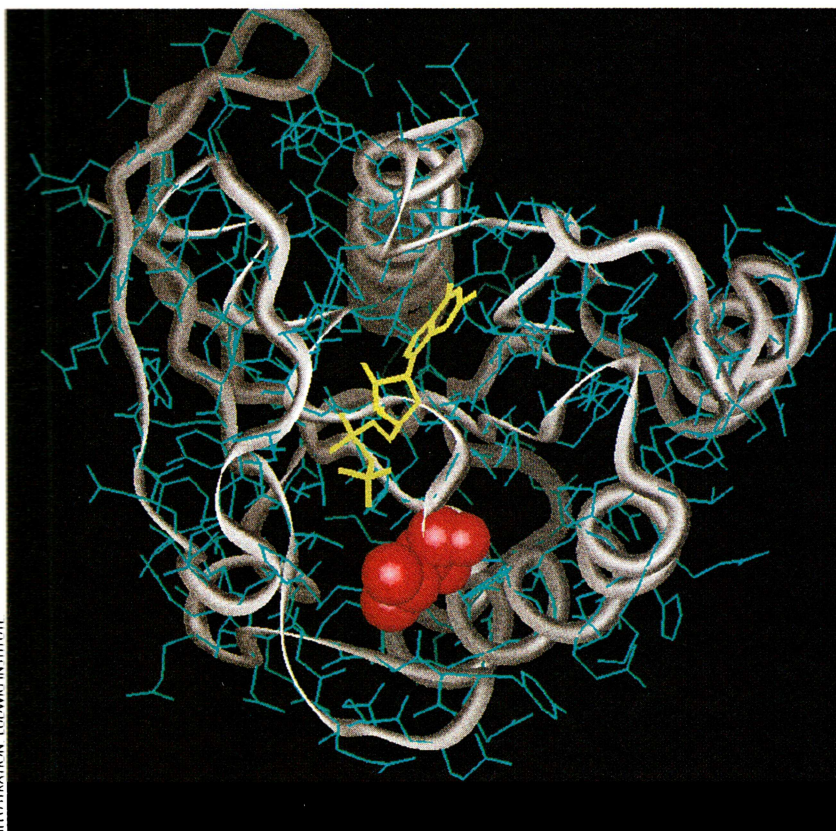
cancerous mutation slips through the normal production system. If our cell production systems are perturbed, for example, by chemicals in the environment that induce or promote mutations, the rate of mistakes during DNA synthesis increases and there is a corresponding increase in cancer.

Lifestyle changes and cancer tests can reduce the risk for some cancers (eg. stop smoking, protect skin from sunburn, Pap smears or mammograms) and, although these measures can be expensive, they appear to be quite effective.

Preventative measures need to be applied to large sections of our adult populations. In the hope of reducing deaths from cancer, scientists and doctors are working on all aspects of these problems: reducing environmental risks (especially diet, sunlight and viruses); improving treatment (by reducing side-effects, developing new anti-cancer drugs and introducing biological techniques for controlling the effects of cancer), identifying people at high risk (through heredity, their work environment or age/sex).

Complex problems rarely yield to frontal attacks. Understanding the genetics of cancer has been no exception. It has taken almost 90 years to identify the genes responsible for most cancers. The first human cancer gene was first identified as a result of studies on mice. Scientists exposed mouse cells to DNA from human cancer cells and were able to transmit the cancer to mice. This first cancer gene was called *ras* and we know that the cancerous form of *ras* occurs in many common cancers – eg. colon, pancreatic and lung cancers. In normal cells, *ras* is a tiny

"Mutations in a gene called p53 occur in more than half of the six million human cancers diagnosed every year."



The first cancer gene: a computer-drawn representation of the cancerous form of the *ras* protein, which occurs in many common cancers.

chemical on/off switch which controls cell replication. The cancerous form is locked in the 'on' position and cannot be turned off. The design and action of the *ras* switch is known in exquisite detail and scientists are developing chemicals to neutralise the effects of its cancerous form.

Fortunately cancer is not usually the result of a single mutation, so even though mutations of *ras* might occur, if we could detect the presence of cells with the mutant form of *ras*, steps could be taken to remove or attack the pre-cancerous cells.

Although the mutated form of *ras* occurs in all pancreatic cancers and in more than half of all colon cancers, it is not the most common genetic change associated with cancer cells. Mutations in a gene called *p53* occur in more than half of the six million human cancers diagnosed every year.

Fifteen years ago, when *p53* was

discovered, very little attention was given to the gene; it was a protein associated with the action of a virus which causes animal cancers but nobody dreamed it was connected with human cancer. It was not until 1989 that scientists discovered that more than 80% of colon cancers carried mutations which destroyed the function of the *p53* protein. Without *p53*, cells do not follow their normal life cycle. Instead of maturing and dying, cells with defective *p53* retain their ability to divide, and if another cancerous mutation (eg. *ras* activation) occurs during these extra divisions, cell production escapes the normal control systems and the cells can grow all over the body.

The viruses which cause cancer in animals have alerted scientists to the existence of many cancer genes. However, human geneticists have also uncovered genes which appear to predispose particular families to cancer.

Although inherited cancers are rare, it has already been possible to identify the gene associated with families who inherit colon cancer. Initially it was thought that this gene, known as APC, was only mutated in the few families who inherited colon cancer. However, once the APC gene had been identified, it was soon apparent that more than three-quarters of all colon cancers contain a disrupted form of the APC gene.

A decade ago, there were very few clues to the genetic basis of colon cancer and there were no real targets for chemists or biologists to aim at when designing anti-cancer therapies. We now have three large targets: *ras*, *p53* and APC. A huge pharmaceutical effort is under way in an attempt to discover anti-colon cancer drugs which will reverse the action of the *ras*, *p53* or APC mutations. The success cancer geneticists have enjoyed with colon cancer has inspired teams all over the world to identify other cancer genes. Success is not far off for the groups working on breast cancer genes and melanoma-associated genes. In some forms of breast cancer there is a strong hereditary link, and the characterisation of this gene will undoubtedly provide an opportunity for identifying women who have a high risk of developing breast cancer.

Several new opportunities have strengthened our position for the war on cancer. Firstly, cancer screening and awareness have increased dramatically. The identification of the major risks associated with lung cancer (smoking) and skin cancer (sunburn) and the success of the Pap smear test for reducing deaths from cancer of the cervix have encouraged communities to introduce further large-scale screening programs. Recently, mammography has been introduced to help with the early detection of breast cancers and there is considerable interest in extending cancer screening to include tests for colon and prostate cancer. Although the

"The major challenge of this decade is to develop new methods for selectively attacking and killing cancer cells."

costs of individual tests are not particularly high, when millions of people are screened on a regular basis the cost to government appears to be expensive; however, these expenses need to be balanced against the costs of treatment for advanced cancer. In Australia the annual cost of treating colon cancer exceeds \$300 million. It is imperative that the present tests are made more reliable and informative. In this way, people in danger can be identified and treated or assured their risk for particular cancers is low.

The combination of the recently discovered genetic information with traditional tests offers an opportunity to increase the power of screening procedures. Pap smears combined with tests for specific papilloma virus genes are expected to identify high-risk patients much more reliably than Pap smears alone. Younger women who appear to have a low risk from the results of both tests will not need to be tested as often. Similarly, it is envisaged that women who have particular forms of the breast cancer gene might be advised to undertake more frequent monitoring than other women who have normal genes at this genetic locus. By combining genetic analyses with colon cancer tests, it should be possible to reduce the number of people who will need extensive hospital-based examinations for early colon cancers. It is already clear that early detection facilitates effective surgical removal of many cancers, so there is an expectation screening programs will lead to lower cancer death rates.

The reliability and predictive potential of various cancer tests need to be assessed objectively. Inconclusive tests can lead to considerable confusion and significant escalation of costs to the health system. The immunological blood test for cancer of the prostate is becoming extremely popular in the United States; however, the ability of this test to distinguish between dangerous or benign forms of this disease is limited. Reliable tests for prostatic cancer will

need to await genetic methods which distinguish between the malignant and the benign forms of the disease.

Although improvements in cancer treatment have been slow, many new combinations of anti-cancer drugs have been developed. When combined with improvements in surgery and radiation, these combined modality treatments are improving patient outcomes significantly. Although very few biological therapies have been used to attack cancer cells directly, we have witnessed the introduction of more effective support therapies. As a result, cancer patients are able to receive higher doses of anti-cancer agents. In this decade we will not only see the introduction of new immunological, genetic and antagonist therapies designed to increase the effectiveness of current cell-killing treatments, but also radical new therapies based on the transfer of genes to cancer cells.

ONE OF THE IMMEDIATE side-effects from many cancer treatments such as high-dose chemotherapy is the loss of production of white blood cells. As a consequence, cancer patients have been at risk of serious infections and bleeding disorders. The discovery and use of two hormones, GM-CSF and G-CSF (these hormones are also called cytokines), known to increase the production of white blood cells is already altering cancer treatment. These hormones accelerate the recovery of white blood cells in patients undergoing intensive cancer treatments and allow cancer trials to include significantly higher doses of anti-cancer drugs. Recent research in Australia has led to methods which allow GM-CSF or G-CSF to increase platelet recovery and reduce the risk of uncontrollable bleeding.

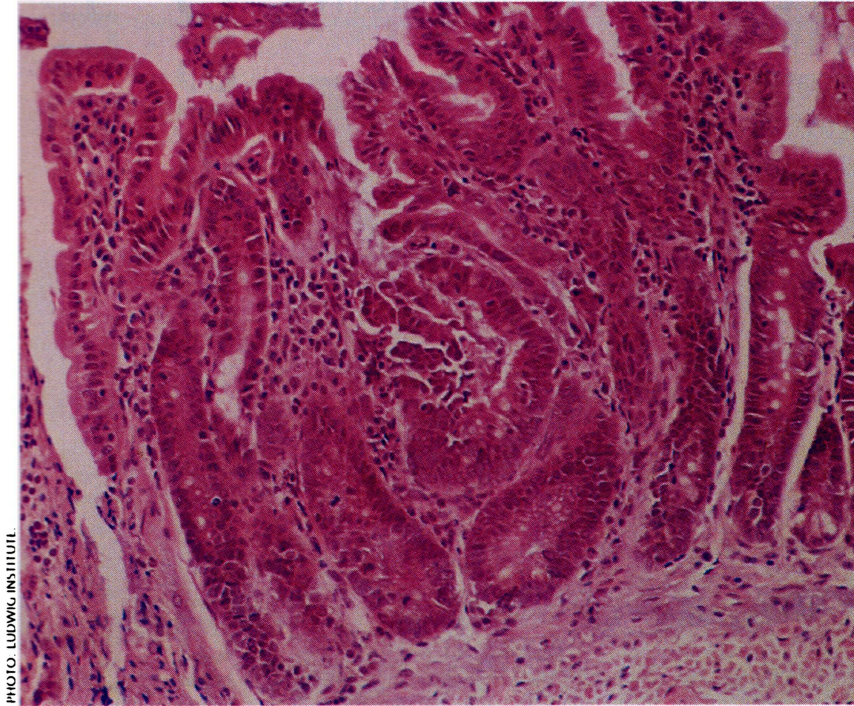
However, the major challenge of this decade is to develop new methods for selectively attacking and killing cancer cells. Our increased understanding of the genetics, biology and biochemistry of cancer provides new opportunities.

Programs are under way for the discovery and development of drugs which will reactivate p53 or inhibit the action of cancer-causing *ras*; immunotherapy programs to improve antibody or cytokine killing of cancer cells are being designed; knowledge of growth factor action for cell production is being used to kill cancer cells which overexpress specific receptors or which rely on self-stimulation by growth factors; and the delivery of anti-cancer genes to control leukaemia, p53 or *ras*-associated cancers are being contemplated.

Immunologists have made many attempts to increase the activity of the immune system so that cancer cells would be recognised and rejected. Until recently, researchers lacked sufficient knowledge of the immune system to achieve their goals. However, it is now known that specific peptides (small protein molecules) can occur on the surface of cancer cells. The 'display' of these tumor-associated peptides allows the development of immunisation protocols designed to produce cells called T-lymphocytes which will kill the cancer cells. Specific peptides have been identified on the surface of melanoma and breast cells, and from animal models it is known that specific T-lymphocytes can be generated to kill cells displaying these peptides. Since a high proportion of cancer cells contain mutant forms of p53, attempts are being made to detect mutant p53 peptides on the surface of particular cancer cells. The peptide would provide a very specific target for the appropriate killer cell.

In many brain cancers there is an elevated (30-fold) expression of epidermal growth factor (EGF) receptors. These receptors provide a target for radio labelled or toxin labelled antibodies. Localisation and even tumor killing have been achieved with antibodies. However, these treatments have been curtailed because the most effective antibodies have been produced in mice, and the human immune system soon learns how to recognise mouse antibodies and

"Pap smears combined with tests for specific papilloma virus genes are expected to identify high-risk patients much more reliably than Pap smears alone."



The start of a colon cancer: Normal crypts (microscopic folds or recesses) surround a disorganised clump of cancer cells in the centre of the image.

neutralise them before they can kill the tumor cells. Advances in computer technology and genetic engineering now allow the production of a range of antibody-like molecules based on human antibody structures. These antibodies can still recognise the human cancer cells, but are not rejected by the immune system. By combining antibody therapy with traditional chemotherapy, scientists have demonstrated effective killing of human cancer cells in animal models. Undoubtedly clinical trials with 'humanised' antibodies, combined with conventional anti-cancer drugs, will be commencing shortly.

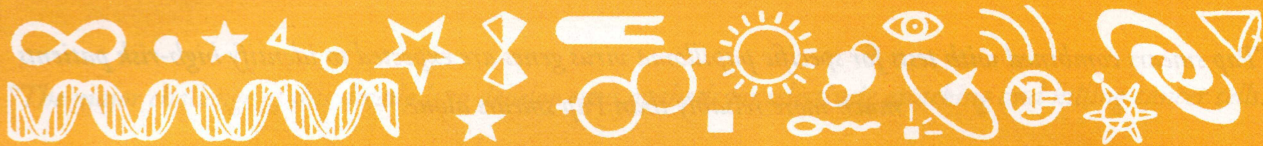
The immune system has some inherent ability to recognise cancer cells, but it appears rare for tumor rejection to occur spontaneously. The effectiveness of the immune system can be boosted by engineering the human tumor cells to produce cytokines such as GM-CSF or interleukin-4 (IL-4). This can be accom-

plished by introducing the genes for these cytokines into surgical samples of the tumor, irradiating the tumor cells and reintroducing the IL-4-producing tumor cells into the body. In many cases, both the IL-4-producing tumor cells and the original tumor cells are killed.

The mechanisms of tumor killing are still not fully understood; however, one molecule known to be involved is called tumor necrosis factor (TNF). High local concentrations of TNF are very effective anti-tumor agents, but this molecule can be quite toxic to normal cells, and the body has developed mechanisms to neutralise its action quickly. One mechanism is to produce a soluble form of the receptor for TNF. This binds to and neutralises the action of TNF. It has been shown that antibodies which neutralise the soluble TNF-receptor can augment the action of locally produced TNF and increase tumor killing.

Some tumor cells appear to produce specific growth factors which are required for their survival. For example, particular cancers of the lymphoid system (such as multiple myeloma) and melanoma produce interleukin-6 which stimulates the growth of these cells. Antibodies which neutralise the action of interleukin-6 kill these cancers. Similar results can be obtained with antagonists of interleukin-6 and even 'anti-sense' nucleic acid molecules which inhibit the production of interleukin-6. These anti-sense molecules block the expression of unwanted genes in two ways: by binding to the messenger molecules (called messenger RNA) that carry the genetic code from a cell's DNA; or by binding to the so-called 'junk' sections of precursor DNA molecules, which prevents the cell expressing any part of a gene. Experiments are under way to test the efficacy of these anti-growth factor treatments in human cancer trials.

The introduction of anti-cancer genes into cancer cells is being attempted by many laboratories. Genetic lesions are known accurately in a number of cancers (eg. chronic myeloid leukaemia, where there is a unique chromosome rearrangement which produces an enzyme called *bcr-abl*). It is conceivable anti-sense oligonucleotides (molecules derived from short lengths of DNA or RNA) might be introduced via an appropriate genetic vector or carrier to inhibit the production of the mutant proteins or replace the loss of p53 function. At present the range of vectors suitable for use in humans is limited, so the effective delivery of genetic agents remains problematical. However, viral vectors directed towards proliferating cells or with specific target recognition sequences are being designed. It is clear that a few years' experience will lead to more effective approaches for gene therapy and many clinicians are quite optimistic about its potential for improving cancer treatment.



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The futurist and acclaimed author, Alvin Toffler, is a 21st century version of a medieval cartographer making maps to show the great explorers the way to the New World. Toffler's maps reveal a global culture built on transparent technologies, short on privacy, increasingly controlled by the media, and overloaded with information.

FOR MORE THAN TWO DECADES, ALVIN TOFFLER, 65, has been deeply entrenched in the future, tantalising and preparing businesses and individuals for the constantly changing, technology-driven environment ahead.

Modern civilisation teeters on the edge of a new century which promises to be highly complex, high-tech and funded by the currency of information. Toffler's view is that information is already the central resource of the economy, but even greater change is coming.

A former factory worker, journalist, editor of *Fortune* magazine, and the man who introduced the term 'future shock' into the vernacular in 1970, Toffler emphasises the far-reaching global implications of the information age (and those to follow) for our systems of business, politics, education and culture. His works, *Future Shock*, *The Third Wave*, *Powershift* and the recently published *War and Anti War on the Edge of the 21st Century*, form an insightful and sweeping synthesis of the emergent civilisation of the next century.

Toffler argues that the central economic importance of information or knowledge can be seen in the explosive growth of service industries, the burgeoning momentum of global media empires, and the proliferation of personal computer networks and other information delivery mechanisms from wireless phones to satellites and the emerging information superhighways. With this type of ubiquitous information infrastructure, enormous changes are afoot.

Toffler says: "We have had more than a generation now to adapt to the new environment that we find ourselves in – one of accelerated change and high complexity driven by global markets and information technology. Businesses are getting the hang of it because profit is an enormous motivator for change. But whatever changes have taken place in our political and educational institutions have been trivial. They are still factories which represent a monopoly.

Businesses have been experimenting for some time. By contrast, these other sectors have been most recalcitrant and I believe are in for dramatic change. We are all headed for some kind of political perestroika."

But the information age as society has come to know it is almost over, he says. In its place will be a new era where our traditional perceptions of culture are exploded. He calls it an age of "culture-busting", a direct result of new technologies and new uses of technologies that will become prevalent within the next decade or so.

"We are moving beyond the age of information technology to cultural technology. That means the technology that affects language – we *are* going to have language translation technology – and technologies that give us the ability to access foreign sources of information. When the skies are filled with satellites and optic cable is stretched to our homes, they are going to be pumping television into our homes from absolutely anywhere, in our own language.

"That affects the very deepest fundamentals of culture. It allows us to take a bit from here and a bit from there and configure a new personality and culture that is totally unique to the established perceptions of our cultures today. You will still have an Australian culture, or a Malaysian culture or whatever, but it will be a very different Australian culture to what you have now."

Toffler is critical of the shortsightedness of most of the world's economists, political leaders and financial institutions who, he claims, do not look beyond the largely superficial cycles of economic growth or decline as the catalyst for significant structural adjustment.

"There are two things going on at the same time and one is much deeper than the other. At one level we have the economic cycles of boom and bust as the background radiation of the system. But that is the more traditional dimension. More significant is the revolutionary restructuring of markets, of organisation, culture, technology and



PHOTO: SCOTT BENHAM

"What's happening is that the corporations are so complex, and technologies and markets are changing so rapidly, that the people on top simply don't know what the people doing the job need to know".

work. The cycles of boom and bust may oscillate, but when you put the deeper trends together, massive cultural change on a global level is irreversible. We can't go back."

Toffler describes the wide scale restructurings that have been on the agenda of many of the world's largest companies throughout the late 1980s and early 1990s – from IBM to Westpac – as 'practice' for the main event now looming.

"The assumption of the 'second wave' post-industrial corporate structures was always that the people on top always knew what the people down below needed to know to do their jobs. It therefore also assumed what those people down below didn't need to know to do their jobs. Bureaucracy rested on this hidden assumption and it is completely irrelevant today and will be complete suicide in the future.

"What's happening now is that the environment is so complex and the corporations themselves are so complex, and technologies and markets are changing so rapidly, that the people on top simply don't know what the people doing the job need to know. So leaders must get the message. They must give workers these information tools and the right to make decisions. You can't have people down below performing well for the business if they don't have the freedom to seek information as they determine they need it. And that requires a transformation of traditional information systems.

"Information was always useful as a competitive force, but now it is the central factor of production. What I mean by that is if you look at what economists have traditionally called factors of production – they point to land, labor and capital. Sometimes they include raw materials. But they leave out the word knowledge or information. That is information that is transformed into strategic knowledge by the combined elements of content, time and context. Now you can use knowledge to reduce your other inputs. You can reduce your labor input, your energy, time, capital and space inputs by having the right knowledge in the right place at the right time."

The exploitation of information as a central political, economic and cultural force is most prevalent in the media. New technology and new uses of technologies are behind the media's increasing power and influence over our local and international environments. Toffler says this trend toward a media-centric world will only accelerate and he is concerned by it.

"Especially when it can so easily set the agenda for outmoded 'second wave' political and educational institutions that are incapable of making their own decisions.

"What we have now is the media setting not only the

agenda for political debate, but it is also setting the pace with which decisions are demanded. So for instance, one day you see starving children in Somalia and American troops go in. And the next day you see another image of an American soldier being dragged through the dirt and Congress says, "well, out they come". The media provides a pressure that forces the outmoded political system to make decisions on things it really doesn't know a hell of a lot about. They are information overloaded, decision overloaded and incapable – no matter how intelligent their members are – of making intelligent decisions. The problem is, who elected the media? If you regulate the media you run the risk of death to democracy. And if you don't regulate the media or make it accountable in some way, then you risk the death of democracy also."

JUST HOW MUCH BUSINESS AND SOCIETY ADOPTS THIS new perspective of information for strategic uses or otherwise in the 21st century, depends to a large degree on how the emerging information superhighways and other information networks are rolled out. Toffler is very cynical of the "campaign speeches" flowing from many of the world's business and political leaders on matters like the superhighways, but he says the one certain element to come out of this hype is that the information highway infrastructure will be built.

Indeed, the political and business activity surrounding the information highway concept is frenetic. Governments in most of the world's major economies have realised that the future wealth of their economies will be inextricably linked with having a national and international information infrastructure. But the logistics of building that infrastructure – a balanced mix of cable and wireless delivery mechanisms – are enormous. The world's media, entertainment, telecommunications and software companies – from Microsoft and Time-Warner to Sony and Murdoch's News Corporation – are scrambling for alliances, and acquisitions to position themselves for a lucrative share of information highway standards and services.

Toffler says: "This is not just Time Warner, Microsoft or QVC. This is an historic event. It is changing the neural system of the entire planet and any country that doesn't have an information highway or something equivalent will be out of the global political and trading arena. We just won't be able to separate these information and communication issues from business competitiveness or national and international foreign policy issues. Right now we are seeing many companies, and political leaders championing this brave new world with campaign speeches that border on the ridiculous and

"The information age as society has come to know it is almost over. In its place will be a new era where our traditional perceptions of culture are exploded."

naive. Many of these companies that are trying to identify areas of profit potential from things like superhighway projects will fall by the wayside. And I think we've had enough experience with new technologies, new media and communications technologies to set aside any notion that this is all going to be used for high-minded education.

"But, the infrastructure will be built and it really doesn't matter to me whether the profits go to company A or company B. But whether the infrastructure implies universal access is something I think we will be fighting about for some time because nobody wants to pay for it.

"It is in the interests of the commercial powers to make the system ubiquitous. The more people in the system the more effective it is for the purposes of these big companies. Therefore, there are forces working toward universal access. But the real issue is where is the money going to come from?"

TOFFLER IS MORE CONCERNED with the issues of privacy which these vast information-centric electronic networks will usher in. And he says that any debate about information highways should highlight the privacy conundrum.

"Privacy in the 21st century – even before then – is going to be an enormous issue for all levels of society," says Toffler. "I was far more casual about this 20 years ago because I believed the benefits of information and communications reform far outweighed general risks to privacy. Now I no longer think that way. The threats to privacy are too big to make that mental trade-off. Most debates about privacy in the past centred on the individual's right to privacy from governments. But in the world we have now, and indeed will have in the future, privacy leads into this whole area of electronic terrorism and here I think we are remarkably casual and stupid. Individuals, governments and businesses are all at risk from each other. And our current systems of security, legislation and general policing bureaucracies are hopelessly ill-equipped to deal with any of it. And I don't think any serious discussion will occur until there are some really terri-

ble examples. I know of a few already."

Recently, the Swedish Prime Minister, Carl Bildt, decided he wanted a word with US President Bill Clinton. Rather than pick up the phone, Bildt used his personal desktop computer to send an electronic "Dear Bill" message to the White House, congratulating the President for ending the trade embargo on Vietnam. Clinton later responded with a "Dear Carl" e-mail message, thanking Bildt for his support.

The medium for this diplomatic chit-chat was the Internet, the global communications network accessible using a PC and a modem. The Internet, with more than 20 million users is the closest thing the world has to an information superhighway. As a result, the Internet is at the centre of business and political debate with cries to "open-up" the Net (privatise it, in a sense) to provide more commercial services. The fact that the Internet, which has been operating quietly since 1969, building a unique class and cult of users, could now be a centre of controversy, is evidence that the

information era has come of age. The information age, like the products and technologies that have driven-it, is messy, confused and often remarkable. But Toffler says these networks and technologies are about to mature very rapidly.

"There is absolutely no reason to presume that the way we fumble and cringe at many technologies today – from a PC to a VCR – will be the way our children will approach it in the future. We will be 'swimming' in this information-rich environment like fish in the ocean," says Toffler.

"We'll use various devices in that environment for different reasons. We'll use some often and others only occasionally. Some services will be free, but many more will be time and fee-based. But we won't think about it like we do now. Information technology will be far more transparent. The Dick Tracy watch is not a fiction.

"I think experience has shown we should never say never. The big one is the binary combination of computers and genetics. The fusion of those areas of research and development has not occurred yet. But it will, and when it does all bets are off."

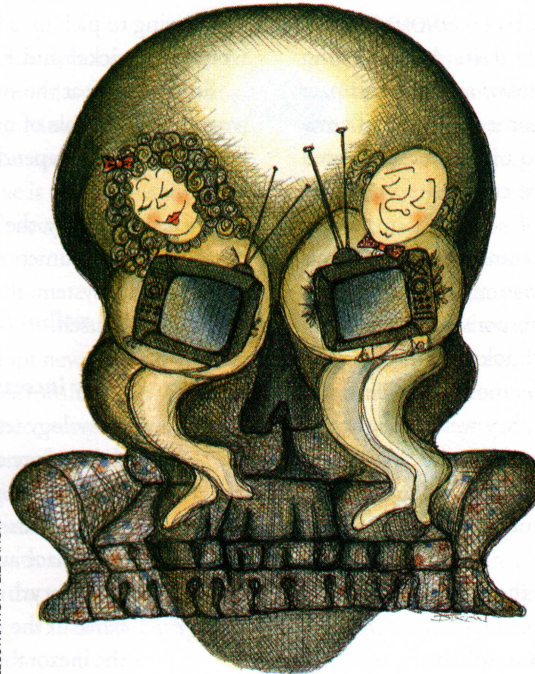


ILLUSTRATION: LIZ DIXON

Learning to live with technology

New technology presents consumers with a dilemma. On the one hand, we look to technology to deliver us into a Golden Age of Leisure; on the other hand, we harbor deep fears about its impact on jobs, privacy, our sense of values, and even our relationships with each other.

AUSTRALIANS ENJOY TALKING ABOUT TECHNOLOGY, EVEN when they don't understand it. As the thing called 'technology' makes more and more impact on our lives at work, at home, in the retail environment – indeed everywhere – we accept it cannot be ignored and that, however reluctantly, we must continue to come to terms with it.

Human nature being what it is, consumers of new technology are caught between a number of contradictory attitudes. On the one hand, they recognise their responsibility (and their wish) to 'keep up', and they regard technology as creating the pathway to a brighter, more comfortable, more convenient and more efficient world for mankind. Yet they worry about their own tendency to 'go overboard' about new technology and they fear there is a kind of technological roller-coaster which may turn out to be unstoppable.

The deepest underlying concern, though, is that as we invent smarter and smarter machines and embrace them with increasing enthusiasm, will the machines designed to be our servants end up being our masters? Will we become the victims of technology?

That fundamental concern has produced five moral questions which arise when Australians talk about their experience of contemporary technology.

Are we becoming too dependent on our machines?

Even while they are marvelling at the wonderful things technology can do for them, consumers worry that, by learning to jump through the machines' hoops, they are not only conditioning themselves to adapt to life with technology, but actually becoming dependent on the machines' way of working.

Housewives who fell upon the automatic washing machine with joy, saw it as a way of saving time and effort. Now, looking back, they wonder whether they are spending just as much (or more) time and effort on washing as their mothers did, simply because the machine makes washing so easy that they do it every day instead of once a week.

Even the humble vacuum cleaner has occasionally caused consumers to stop short:

"I was vacuuming the carpet the other day and I found I was going backwards and forwards, over and over a particular

spot, trying to pick up a bit of cotton. Finally, I realised that it would be quicker and easier to bend down and pick it up."

In the bank, at the supermarket and even at home, people worry about the loss of numerical skills which may result from becoming utterly dependent on machines to 'do our thinking for us'.

More insidiously, the enormous convenience of credit cards has led some consumers to worry that, as they have adapted to the credit card system, the system has made them more dependent on credit itself.

Does technology increase unemployment?

As they see technology (especially computer-based technology) doing more and more of the things that used to be done by people, it is hard for Australians to avoid the conclusion that computers are invading the workplace and replacing people.

Everything from the computer system in a bank to the robots on a production line points to the inexorable shift towards using machines, rather than people, whenever they can be designed to do the job more efficiently than people can.

This is part of a long-term trend, over hundreds of years, of course. We consistently invent machines to save us from tedious, unpleasant, repetitive or difficult work. Indeed, when people dream of the dawn of a Golden Age of Leisure, they regard technology as the thing which will make it happen.

For the foreseeable future, however, technology is both hero and villain when it comes to the workplace. Until we work out how to create new jobs (or redeploy available work) so there is a more equitable distribution of work through the community, people will continue to point the moral finger at technology and blame machines for 'taking jobs away from people'.

Is electronic information really secure?

A growing anxiety among consumers of new electronic, computer-based technology is that information stored and transferred electronically may be more easily subject to unethical practices than in the 'filing cabinet' era.

As consumers become increasingly aware of the possibility of institutions having access to each other's electronic data (for example, contact between banks and government departments)

"Will we fall for the illusion of the 'global village' even when there is no village at all?"

– to say nothing of hackers – they become more generally aware of the security hazards of electronically-stored data. “How private is all that information about me?” is the question.

Anxiety about the security of electronically-stored information appears to increase in direct proportion to people’s understanding of computer technology: those who regard themselves as being ignorant in such matters are generally less concerned, but doubts about the security of electronic information are stronger among those who claim to understand ‘the system’.

The dramatic increase in use of cellular phones has sparked the interest of more people in the security of information transmitted and received via new technology. Mobile phones, in fact, symbolise the exquisite dilemma of the consumer when faced with new technology: the mobile phone is regarded as the most desirable and most convenient of all new technology, yet its perceived lack of privacy is a worry.

Is new technology making us into ‘mindless consumers’?

Recognising their own tendency to adopt new technology with alacrity (microwave ovens, VCRs, mobile phones) some consumers believe Australia is simply becoming more materialistic and that the constant invention of new technology is fuelling our desire to acquire more and to be ‘up with the latest’, regardless of the real value of new technology to us.

Again, this has something to do with the fear that we will become dependent not only on what the machines can do for us, but also on the idea that technology will always have a new trick up its sleeve.

“The computer is too slow to handle the new software, but everyone wants the latest software, which means you need new hardware, too...”

“New technology is always more expensive...it is a constant spiral to more spending.”

In spite of the reservations, Australians continue to be driven by a kind of technological imperative which leads them to believe that they *do* have a duty to keep up with the latest innovations and to ‘make the most’ of new technology. There are signs of a ‘machine mind-set’ emerging in which consumers will simply assume that all new technology is better, and that ‘we must have it’.

It is the hazards posed by that mind-set which raise the moral question in the minds of consumers who fear their own submission to the technological imperative.

Is technology de-personalising our society?

This is the big one. Unquestionably, the most pervasive and disturbing moral issue about technology in the minds of contemporary Australians is that, by becoming so attractive and so clever, machines are minimising our contacts with each other.

Parents are already concerned their children may spend so

much time with computers and electronic games that they will sacrifice time otherwise spent in social interaction. That leads to the worry their social skills may not develop as their parents would like.

The same concern is expressed on a larger scale when people look at the inroads which technology is already making into personal contacts at work, at the shops, and at home: “People give you messages on the computer rather than talking to you.”

“Even at the railway station, we are going to have automatic ticket dispensers. I know it is not a big thing, but that is just one more human encounter that will go.”

“You spend so much time interacting with machines that you don’t realise you can spend a large part of your day without actually dealing with another person.”

This concern is tied to the fundamental paradox about communications technology: while machines allow us to exchange information with each other over vast distances and at the speed of light, they also keep us apart from each other.

Discussion of the de-humanising effect of technology taps into a deep concern. Because we perceive an underlying connection between our sense of being a community and our moral sensitivity, the issue of ‘depersonalisation’ becomes a moral issue: people have an intuitive fear that if they allow their dependence on machines to diminish their contacts with each other, the ultimate casualty may be the sense of belonging to a community and, in turn, the sense of moral responsibility towards that community.

After all, it is in our relationships with each other that we learn the sense of mutual obligation which lies at the heart of morality and which makes communities work.

Interactive television, computer networks, virtual-reality machines and the merging ‘information superhighway’ will all, no doubt, seduce us with their talents and charms. But none of them can create quite the same sense of connection with each other which personal contacts do.

If the day dawns (or has it dawned already?) when we find machines more entrancing than each other, what will be the consequences of that? Will we prefer to spend time with a machine that is *always* responsive? Will our children prefer to ask questions of a machine that always listens to them and can always provide an answer? Will we choose to spend even less time with each other? Will we fall for the illusion of the ‘global village’ even when there is no village at all – and none of the *incidental* contacts with each other that are the essence of village life? Will we ultimately confuse the exchange of data on a screen with personal relationships?

No wonder there’s a hint of concern in the community: these are issues which warrant more than a passing thought as we rush towards our technological future. History certainly tells us that the machines we create to serve us are bound also to shape us.

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Gates' expedition to the living room

William H. Gates is one of the explorers of the information age. At 37, he is one of the richest men in America, and chairman of the Microsoft Corporation, a software firm that employs 14,500 people and earns \$A5 billion a year. Widely disliked in the computer industry for his aggressive business methods, Bill Gates has been described as "the new Rockefeller". His long-held belief is that one day every home and every desktop will have a personal computer, preferably one dependent on Microsoft software.

BILL GATES IS ON A MISSION which he admits is like no other he has ever attempted. Having successfully dominated the booming market for personal computer business software with his Disk Operating System (DOS) and the Windows graphical user interface, Gates has set his sights on a new area of opportunity – our living rooms. To do that, he has become a zealous promoter of the information superhighway concept.

Gates, the businessman and genius programmer, is unsurprisingly optimistic. He espouses a new era where an enormous variety of information and entertainment will be at our fingertips, enriching our lives, making businesses more profitable and governments more democratic and responsive. As a high profile pioneer and developer of new computer software and other information technologies that will dramatically alter the way we work, communicate and entertain ourselves, Gates is pushing the future closer toward us with ever greater intensity.

Not unlike Alvin Toffler, Gates foresees a new era of widespread change in global businesses and government services. But it is change he hopes his software will provide the catalyst for. During his visit to Australia in February he met with key business, media and political leaders – in particular Prime Minister Paul Keating – to argue his case.

Gates also signed a deal with Telecom to provide a new interactive on-line information service that by the end of 1994 will carry news, e-mail and other multimedia services to businesses

and governments. Telecom will provide the communications backbone to carry a range of easy to use interactive news, e-mail, videoconferencing and other graphical services that will be handled by Microsoft software. It is effectively a pilot to give users a taste of services they might expect an information highway to deliver to their homes.

Gates wants to control the standards for information highway software, just as he has in personal computers, and he is cleverly exploiting the hype surrounding the superhighway debates to promote himself and his company as a key component of it.

Gates says; "The Press loves to write about things like information superhighways because they are at the centre of it. They could be out of jobs, reshaped, enriched, merged, some think Big Brothered. It's one of those topics that even in the early stages gets a lot – a lot – of attention. You know, aspects of all this are completely out of control, but at the core, it is healthy. It would be awful, if say we had a mania about something that had absolutely no value to it. That really would be awful. At least here at the core, there is something of very deep importance.

"The fact that things get a little crazy – that people go overboard, the fact that certain companies get funded who shouldn't, the fact that certain mergers are done

that shouldn't be done, certain company valuations are driven-up that shouldn't be – that's what you get when you have mania. But it's human nature – or at least business nature."

Gates says he was impressed by Keating's grasp of the critical issues and implications such a service can provide for the country in terms of education, trade and foreign policy. Keating, says Gates, had a view of the information highway structure that was very much in keeping with the Prime Minister's reasons for vigorously promoting the Asia Pacific Economic Conference (APEC).

"Keating was really very impressive. He saw the information highway as not just a thing by itself but very consistent with his broad goal of where he wants Australia to go," Gates says. "Before we went in, we thought that maybe he had just gotten the 'media mogul's view' of this thing and we were ready to say 'OK – put all that about Pay TV and news stuff aside and now let's talk about education, let's talk about government services'. Really that's what we went in thinking. But he understood that distinction before I could open my mouth. I got to skip over a lot of basics."

Gates says businesses and wealthier residents will be the first beneficiaries of an information highway, simply because it makes more sense to

"When governments, cable companies or anyone else finally decides to put in the billions of dollars necessary, they better pick the best software – no matter who has lunch with them, or even dinner."

trial the types of applications that will make such a infrastructure meaningful.

"The more dense areas – and dense not just in terms of population but application opportunities as well– will be the first that are economic in terms of deploying it. Whether you subsidise rural and other remote regions is a bigger issue. Some economists have come up with various models, but they too will have to be tested. We did talk about openness (with Keating), that any company could come on to the network and the idea that the pricing of the network, had to be separate from the people that have content – the difference between regulating access charges and letting free-enterprise determine the cost of the content and services that flow over it."

THERE WILL STILL BE A WHILE TO wait, however. "Even in the US, nobody's building this stuff out yet. Nobody's even doing decent pilots yet. They are all terrible. They are very limited and certainly would never prove that it is wise economically to build the infrastructure. It will be sometime in 1995 before any decent pilots are done. You know, we have to get some government applications, get the local news providers, some of the universities with the things they want to do – some things that are just adopted for this market and some things that will have more of an impact on the international scene. The best you could say is that somebody ought to start building infrastructure in 1996.

"But before they make that decision, when governments, cable companies or anyone else finally decides to put in the billions of dollars necessary to build it, they better pick the best software – no matter who has lunch with them, or even dinner. They had better take the data from those pilots and employ the best software because if one software can generate 20% more revenue than the other, the difference on paying back that network...you know it's mind-blowing the leverage that creates.

"But I'm a great believer in free-enterprise and competition. Everybody competing helps to get the vision in

their head of what this thing could be. I could also tell you why our approach is better but that's a detail. The key issue for governments is: Does the information have a lot of promise to improve a broad set of things including education, business and government. The key for us (Microsoft) is to do enough pilots so that we can say with some confidence 'look we tried all these different approaches, network topologies, of software and of the box at the end.' And having done that for 18 months, if we then could create this huge incentive for

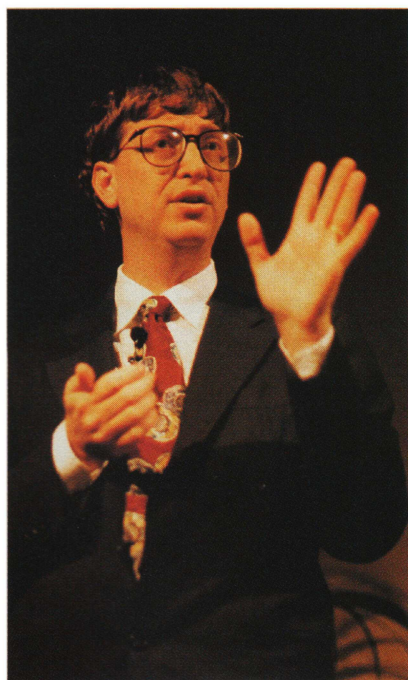


PHOTO: VALERIE MARTIN

Gates in Australia: the new Rockefeller was "impressed" by Keating's grasp of information issues

private firms to just roll this thing out. That is the ideal scenario for us."

Unlike Toffler, Gates continually shrugs off questions and concerns of privacy issues. "Technically, it's no big deal. Security and privacy – at a technical level – is quite easy to solve. Eventually I think everyone will have their own code or something like that. But I think government has the key

responsibility for generating debate on privacy. We just write the software."

Before home-users are ready to embrace new uses of technology and information services from the home, Gates says much of the emphasis in software development has to be on ease of use. He has 500 programmers at his Seattle headquarters working on next-generation graphical interfaces and other software operating systems such as CAIRO that are intended to achieve the 'intuitive' approach to technology that Toffler talks about.

"What we have done to date is laying the foundations for the massive integration and fluidity that we will have with information technology," says Gates. "New interfaces, from speech, touch, virtual reality, multimedia, will be attached to all sorts of devices, both static and mobile. Some will arrive sooner. Others will arrive later. But we will be able to communicate interactively pretty much wherever we are."

Gates tells us to expect continual and rapid improvements in speech recognition and language translation software and hardware. Expert systems and artificial intelligence software will increasingly form the basis for better and more intuitive applications and services. A range of communications devices, from more sophisticated versions of the existing but new genre of handheld personal digital assistants (PDAs) to cellular phones, will be ubiquitous. Compact discs (CDs) will be the standard storage and retrieval medium for a range of interactive multimedia business, education and home software. Graphical interfaces and high resolution images, he says, will increasingly change the way we view and distribute all sorts of information – from encyclopaedias to coverage of the Olympics.

"One of the reasons I am more optimistic about the credibility of all these things – in terms of when they will arrive and what they will look like – is because I have to be more optimistic".

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"The Press loves to write about things like information super-highways because they are at the centre of it."

Information has a price

Information technology is destined to alter society, but there is danger in accepting that all the changes will be profound and for the better. For example, how much work will be available in the 'infotech' society? What is needed now is a science that views information as an economic commodity, and analyses how the flow and distribution of this valuable commodity influences government, business and everyday life.

AM WRITING THESE LINES AT THE TABLE WHERE, MORE than 50 years ago, I did my school homework. The view has changed – the trees have grown large – but the rural landscape has altered very little.

The kerosene lamp has long gone and the battery-operated radio was transformed when electric power became available. With the diffusion of new technology in the form of cars, trucks, tractors and the telephone, the horse population declined and transport services and mail deliveries were curtailed or even disappeared.

Later on there was television, hailed in the 1960s as the *deinotatos*, 'the most powerful force ever invented' – but it helps keep perspective to recall that the *Argus* in 1853 dubbed the electric telegraph "the most perfect invention of modern times". Such superlatives easily flow from the pen or jump onto the screen.

These may have been smaller incidents in what will eventually be seen as the most fundamental technological change: the information revolution. Perhaps this interconnected set of changes goes all the way back to language and was boosted by the printing press, faster travel, TV, satellites and the computer. We should now be adding networking, imaging, massive data storage and artificial intelligence. Much depends on how we interpret these events. Revolutions have become 'two-a-cent'. Think of the recent developments of fax, CD Rom, multimedia and superhighways.

Whether viewed from my homework table or from other vantage points in a large city, the modern history of IT or infotech displays some central features:

- The process has been slow. Remember that Arthur Clarke's seminal paper on satellites appeared in *Wireless World* in 1945.
- The diffusion is far from complete. The International Telecommunications Union suggests as much as half the world's population is not yet within two hours' walking distance of a telephone, let alone having the modem and password needed to use the worldwide Internet.
- The issue of information rich versus information poor still looms large. After decades of theorising on the role of commu-

nication in development, we should note that the latest proposals for superhighways in the US would give an American high school greater 'bandwidth' than is presently available to quite large countries, e.g. Argentina. This inequality is important if the hopes for electronic networks are to have any chance of being realised. A recent UNESCO report argues that four-fifths of the world's new knowledge is commanded by less than one-tenth of the world's population.

- The technology does not yet seem mature so we must expect the information revolution to continue.

During the last annual Pacific Telecommunications Council get-together in Honolulu – attended by some 1,300 delegates – I listened to Per Hjerpe of Digital list the advantages of the 'network of networks' which would make all data accessible at any time. The list seemed endless: telecommuting, telemedicine, infotainment, electronic commerce, videoconferencing, telecollaboration, edutainment, customised electronic publishing, home shopping and banking, electronic town meetings, electronic community interests.

All these were deemed possible and affordable with two provisos: first, the private sector must be given sufficient incentive; and, second, the right socio-economic infrastructure must be created to ensure people are able to reap the advantages. But who knows what is the 'right' infrastructure and where is the serious research into these processes of change being done?

Such presentations are curiously silent on the role of technological change in creating and destroying jobs. Perhaps it is possible to have too much of a good thing and the notion of optimality should be brought to bear on the concepts of choice and change.

The leading edge is now superhighways US style. We are urged yet again to emulate what is done elsewhere – this time it's the Al Gore initiative – because, or so it is said, these new data highways, or more specifically investment in telecommunications equipment, is the linchpin in national productivity and a pre-condition for international competitiveness.

The rationale for information infrastructure and services

"As much as half the world's population is not yet within two hours' walking distance of a telephone."

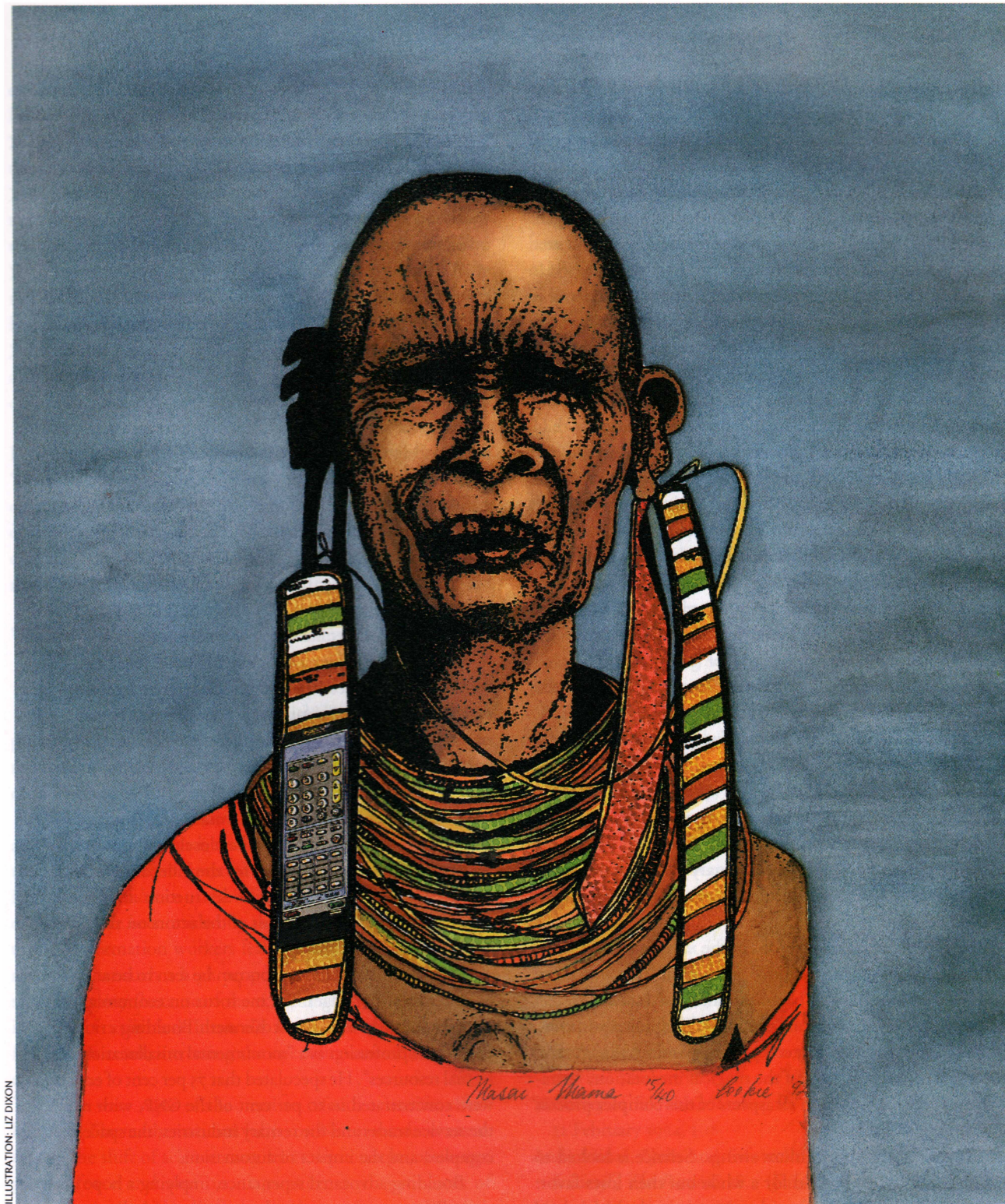


ILLUSTRATION: LIZ DIXON

that is put forward most frequently is that information is an essential resource for good management, productivity gains and development generally. In practice, the mere presence of IT, even expenditure on IT, is often taken as proof enough of the beneficial use of information. The great gap in analysis remains, however, the use of information and its impact on

consumers, business and government. Michel Menou, who will speak at the International Telecommunications Society Biennial Conference in Sydney next July, points to the serious questioning that has arisen regarding the "relevance, appropriateness and sustainability" of information services.

The linchpin approach tends to neglect the complemen-

tarities, the leads and lags that arise when information activities (creation, handling, storage, manipulation and use) are the dominant call on resources, and it tends to assume the productivity gains are realised. As an approach it follows from what I call the 'information-as-oil' viewpoint: information is the lubricant and it is low cost. Presumably, wise managers know just where lubrication is needed. The outcome is better decisions all round – and enhanced productivity.

But information as a resource can be monopolised and it most certainly calls for management skills that we have yet to identify and master. Conflicts do arise about who bears the costs and who gets the benefits.

'Technology push' advocacy tends to dominate and yet the changes, and especially the payoffs, happen more slowly than expected by technocrats, bureaucrats and politicians.

The technocrats lack understanding of the human and organisational constraints. They do not appreciate the economic significance of the learning process. Of course, economics hasn't been all that helpful in this regard.

The bureaucrats mostly share this element of ignorance with the technocrats and compound it with a lack of understanding of the technological aspects. The politicians for the most part think rhetoric a substitute for knowledge.

Much of the discussion is about the nature and not the volume of work in the future society. Andy Hines of Coates & Jarrett, Inc. told last year's World Future Society's General Assembly about the changes that would affect the farmer, police officer, scientist and teacher.

Common patterns he detected were: practically no one will be exempt; technologies will compete against each other; new IT like networks will have revolutionary effects; and implementation strategies will determine whether IT is to be a boon or a bane to workers.

But he offered no calculations of the *net* effect on employment nor of labor turnover.

One does not have to be an out-and-out Luddite to feel that more attention, both analytically and for policy purposes, should be given to the infotech process. 'Sound' macro- and micro-economic policies and the magical incantation, 'infrastructure', cannot deal with all aspects of this complex process of technological change.

We tend to have pendulum swings. Science is looked to for solutions and supported for a while but then loses favor: the various actors find it safer to leave events to the impersonal market.

What are the options? Public participation requires hearings, calls for submissions, advisory boards and opinion surveys. At worst, these approaches pave the way for capture by vested interests. At best, they achieve a pooling of limited information and may contribute to the resolution of some conflicts. They

cannot remedy the basic lack of knowledge of the infotech processes society wishes to manage.

Infotech has enormous potential although the reality cannot be as pervasive and profound as the technocrats and futurists would have us believe. They seek an outcome that would be optimal in the absence of information costs but all information is costly, even information about prices.

The next major issue concerns the way information is created and used in the economic process. I have no great difficulty with the idea that the difference between Europe in the Middle Ages and Europe today is largely one of information. The transformation was, however, a drawn-out process. We must not jump to the conclusion that by 'injecting' information we can transform underdeveloped into developed and developed into more developed societies.

IF WE ARE TO BE MORE SUCCESSFUL IN REALISING THE enabling effects, there must be a drastic reallocation of research efforts. Australia's R&D effort is now largely funded and organised on the assumption that both science and technology (S&T) productivity, and productivity in general, will be enhanced if there is more coordination of science and technology with economic activity.

The nature of coordination should be subjected to close scrutiny. If industry is failing to improve and become internationally competitive, should industry have a dominant voice in deciding what research leads are most promising and how best to implement research findings?

The distinction between optimisation and innovation has great relevance. Industry must be closely associated with the former but there must be room for the independent S&T that can be the basis for the 'creative destruction' that may bring the substantial prosperity most of the actors on the economic stage allegedly seek.

I suggest that all these actors can be seen to be at fault if we look at the S&T budget. Let me focus on economic research. Back in 1965, the economist Kenneth Boulding criticised the economics profession as a "monumental misallocation of intellectual resources". He speculated that 75 per cent of economists were concentrated in 10 per cent of the GNP, with neglect of the service trades and the tertiary industries, the space-military complex, and the impact of automation.

Boulding advocated repentance, implying a hope of salvation. We must not make the mistake of believing that a Co-operative Research Centre could be salvation. This need for change has, I believe, been clarified in the intervening years. Decision processes and the use of information in organisational contexts have to become a leading edge of scientific effort.

To pick up comment from some prominent contributors,

eg. Herbert Simon, Kenneth Arrow, Dasgupta and David, Michel Menou, I would suggest that:

- what happens in organisations may be more important than what happens in markets;
- research and innovation are information processes, so their economic analysis must recognise the peculiar characteristics of information viewed as an economic commodity;
- the theoretical problems of designing organisation with the combined insights of economics and information science have barely begun to be analysed; and
- the linkages between information investments and the achievement of specific development goals are far from self-evident.

The greatest danger in all this is, as Stanford University's Paul David and Ed Steinmueller put it, fixation on the "distant technological utopia leads many constituent elements of the existing...information system to be viewed as merely a collection of unforeseen roadblocks, extraneous binding constraints...identified as requiring removal if the computer revolution is to proceed".

THE ELEMENTS HOLDING UP THE SHOW TURN OUT TO be very deeply embedded and very difficult to change: how children are taught, mathematical literacy, the teaching role of universities, intellectual property rights, entrenched power. Needless to say, these are not roadblocks that can be brushed aside quickly and without cost. They resist and die slowly, if at all.

The outcome is that the enormous potential is not realised; and even that part that is realised has to have offset against it the added costs of information and adjustment. I suspect this is the true significance of the information economy. Too many observers have been misled by the notion that a high proportion of information workers leads to high productivity. The reality is that such a high proportion can be indicative of a small economy (because of the economies of scale inherent in information activities). It can also be indicative of a high coefficient of friction, increasing the operating cost of the system as a whole.

There were signs of the need to refocus scientific effort long ago. The mathematician John von Neumann drew attention to the shift of science away from the concepts of energy, power, force and motion, to concern with problems of control, programming, information processing, communication, organisation and systems. And in the 1940s the American scientist Vannevar Bush highlighted the information 'overload' problem.

It is not enough for theories of economic growth to put the clock back to the time of Alfred Marshall or earlier and say that an additional factor of production, knowledge, must be

added to the capital and labor of neo-classical economics. We must address and solve the problem largely ignored by the futurists: how to create the capability ingredient.

This is truly interdisciplinary work of the highest priority. It is hampered by a serious lack of empirical data but there could be a rich prize to be won by the nation that best learns how to manage its information resources. Endless rehashing of old debates about communication and regulation may increase awareness but nonetheless fail to give better understanding of the processes and options in the information society.

This bears on superhighways and electronic networks. They must be designed and operated in knowledge of the costs of information and the organisational needs they create. The 'Net' enthusiasts are naively proud of the fact that no one is in charge. They need to stay on the alert. The costs are by no means trivial and those that foot the bill will seek to secure their profits, and that may mean changing the system. There are many actors: elements of industry, advertisers, governments; and the decision context is international.

If the focus is not shifted from infotech to information and its use, the superhighways may prove to be another chapter in the American romance with communication, another technological part of a fading American Dream – "all hype and hope", as Helen Meredith wrote recently in the *Financial Review*.

If we believe that the important rationality does not lie in Master of Business Administration-style techniques of quantification, simplistic technological forecasting, nor even in econometric modelling, but in the tortuous search for what Boulding called "those simplified formulations which are the essence of progress in theory", we must concede we have been on the wrong road. Someone wrote "No matter how far you have gone down a wrong road, turn back". ★

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A new era for home music

IN THIS CENTURY, WESTERN MUSIC has developed a close relationship with the technology through which it is broadcast.

As a result of greater levels of complexity of performing, recording and reproducing music, mass access has diminished. One need only look at the current movers in the music industry and the impact of the MTV generation, to see that success in the 1990s means delivering a highly crafted product, in a visual, as well as an aural way. Our expectations have simply superseded music for its own sake.

Live music too, resplendent with theatrics and special effects to replace the personal rapport performers once had with their fans, has suffered similar depersonalisation. One can't help but think that technology has so far created only barriers between musical creativity, musicians, and normal, everyday people.

But thanks to the development of sufficiently powerful and intelligent machines, we now stand on the edge of a new era. The big news is the emergence of interactive capabilities in the home.

CD Rom technology is renowned for its capabilities in combining audio, text, and images into useable and appealing databases. Recently, two members of the musical elite, Peter Gabriel and Todd Rundgren, launched CD Rom products which give an indication of how and where the interactive dimension might take us.

Gabriel's latest album, *Explorer*, in its CD Rom form, combines the traditional features of an album with an interactive tour of his recording studio and a visit to a world organisation of music and dance (Womad) festival. It lets the listener play and learn about instruments used by the band.

Todd Rundgren takes it one step further in his new composition, *No World Order*. Built to run in CD-I and Macintosh formats, Rundgren has composed a database of more than 1500

musical segments and phrases which the listener can rearrange to create their own composition.

American blues musician Edgar Winter is currently recording an album on a Macintosh system which he states "has changed the way he sees music". Winter's vision is to use the interactive format and digital recording technology to give listeners access to possibilities he has as a musician. By allowing the listener to personalise the primary song forms of the traditional album, Winter hopes to put the audience in the same void of choice, color and emotion faced by the composer.

If composing the music we listen to is not enough to quench the creative urge, then the interactive learning environments are going to bring you greater understanding and knowledge of the world of music.

Several companies are developing a range of products that teach music. These range from the karaoke and play-along type products which create an ensemble environment for people to play in, to more serious instructional varieties. Although in its early days, the boom in video instruction tapes in the 1980s would indicate that it won't be long before the gurus of modern music start sharing their knowledge through the superior interactive format.

One of the great barriers to participation in music is the cost traditionally associated with owning instruments and the difficulty involved in organising a band – particularly in urban environments where space and privacy are limited.

In the 1980s, the early polyphonic synthesisers were, if not an oddity, extremely impractical and unrewarding musical instruments. When digital sampling hit the mass market, synthesisers began to develop the attributes of a fully func-

tional recording studio.

All at once, isolated musicians were given freedom over their choice of instruments and were able to record, modify and archive their compositions. They were also given a range of handy tools which enabled even hopeless musicians to maintain a consistent beat.

That was the 1980s – you can imagine where we are now. Many personal computers (the Macintosh and Amiga in particular), with the right software installed, are better machines than the previous dedicated keyboard products. They are superior in memory and speed, and have the ability to converge sound and residuals.

Unfortunately, unless one is blessed with a lot of capital and some unfriendly technology, there are problems connecting the video camera to musical instruments. The key is to create simple editing environments where musicians can easily organise and compose images, and where film makers can similarly create overlay soundscapes on video.

Personal computers, and the computerisation of home video equipment, are about to make good-quality music videos a garage band reality. Software such as Apple's Quicktime and Adobe Premier, and some of the more sophisticated animation tools available, can be used as source environments for audio-visual production. The PC is the palette on which sound and pictures can be mixed and painted to suit the individual.

At present, it still takes a bit of work to achieve a coherent and acceptable

"One can't help but think that technology has so far created only barriers between musical creativity, musicians, and normal, everyday people."

product with these machines but leading technologists are predicting that by the next century, five year olds will be able to make their own video clips, store their own home movies, or simply play with sound and images like Lego blocks. ★

HP=MC²

The key to success in the IT industry is execution. And execution requires energy and a commitment to getting high-quality products onto the market at the right time, right price and with the right features.

It sounds too easy, really. In fact, Hewlett-Packard has reduced the strategy to a simple formula. It's HP=MC². Believe us, a formula like this could explode a few myths and change the world.

The 'MC²' stands for Measurement, Computers and Communications. These, we believe, are HP's strengths now and into the 21st century.

In a business environment where most rivals share similar technologies, nobody gets light years ahead of the competition. Success is hard-won and long remembered. Hewlett-Packard made the first desktop scientific calculator. That was eons ago – in 1968. The company was a pioneer in the days when PC might have stood for 'pocket calculator'. HP made the first pocket calculator in 1972.

Today, HP ranks first in minicomputers and laser printers, second in workstations, and first in a range of scientific measurement and medical instruments. Personal computers are the company's fastest-growing activity. In 1993, sales of HP products rose by almost a quarter to \$US20.3 billion. That's a lot of success and a lot of execution.

In the future, the company will be applying its MC² strategy to a new objective: merging its skills and experience into technologies to serve a multimedia age.

This is already happening. Earlier this year, Hewlett-Packard won a contract to supply computers for an interactive television system in the United States. The computers will store the movies and catalogues ordered by the system's subscribers.

Doctors in California are currently testing HP's prototype of a 'physician's workstation' – an

MC² device if there ever was. The workstation collects medical data from a network of hospital computers that variously contain information such as patient histories and pathology results, and assembles them for assessment on one computer screen.

The company is also working on software systems to make computers easy to use and program.

Further afield, HP hopes to produce a hand-held computer that also operates as a mobile phone, fax machine and electronic mail box. The machine will provide a wireless link to a computerised database or the printer at your office.

Few other companies have the established skills and experience to produce such multimedia devices. As the worlds of measurement, computers and communications come together, Hewlett-Packard hopes to make a unique contribution to IT that the others will find hard to beat.



Telecommunications trends

Phone cards and mobile phones are just the beginning. Within the next decade, Australians are likely to see the introduction of portable telephone numbers, screen-based and voice-actuated telephones, wireless e-mail, and radio-linked electronic organisers that vet your calls.

Ultimately, people will carry a single card that will integrate access to telecommunications with services such as finance, travel bookings and entertainment.

IS IT FRIVOLOUS SCIENCE FICTION TO CONTEMPLATE THAT by 2001 consumers will carry a single electronic card which gives the user integrated access to services such as transport, telecommunication, financial and entertainment?

On the contrary, the basic technologies to support these so-called Universal Access Services are already available; and within five years, we can expect to see the international cross-industry consortia developed to support the introduction of such universal services.

Whether invoked by means of 'smart cards', personal identification technologies (eg. voice recognition) or simply using existing mass-market magnetic-stripe credit cards, these services will simply exploit two of today's fast-growing telecommunication technologies: the mobile network and broadband.

And provided the system is user-friendly, reliable and fraud-proof, the consumer appeal of using a single identity card to replace a wallet-full of credit cards, plane and train tickets, boarding passes and baggage chits, is obviously large.

Companies as diverse as France Telecom and AT&T are currently experimenting with such smart card applications. Given the rate of change of people's *acceptance* of new consumer technologies, the year 2001 seems a safe bet.

What changes to the basic phone service can Australians expect?

By the end of 1999, Australia will have completed implementation of the new National Numbering Plan. The current 64 different STD area codes will have been contracted to only four (see Fig. 1), each followed by an eight-digit local number when dialling nationally. Freeing up the 04, 05, 06 and 09 access codes will make these number ranges available for future services, such as digital mobile services.

This plan is the most future-proof national numbering plan anywhere in the world today. It allows ample number-

ing ranges for new services and new service providers, including the multiple additional carriers that bi-partisan Government policies will allow after July 1, 1997.

Perhaps the most interesting use of the numbering plan will be to support Universal Personal Telecommunication (UPT). The UPT concept, first developed at Telecom Research Laboratories in the 1980s, and now the subject of international standards development to permit worldwide use, allocates each user one or more portable numbers which they can use, in lieu of ordinary 'fixed' phone numbers, at any public or private telephone, fixed or mobile, connected to any co-operating network.

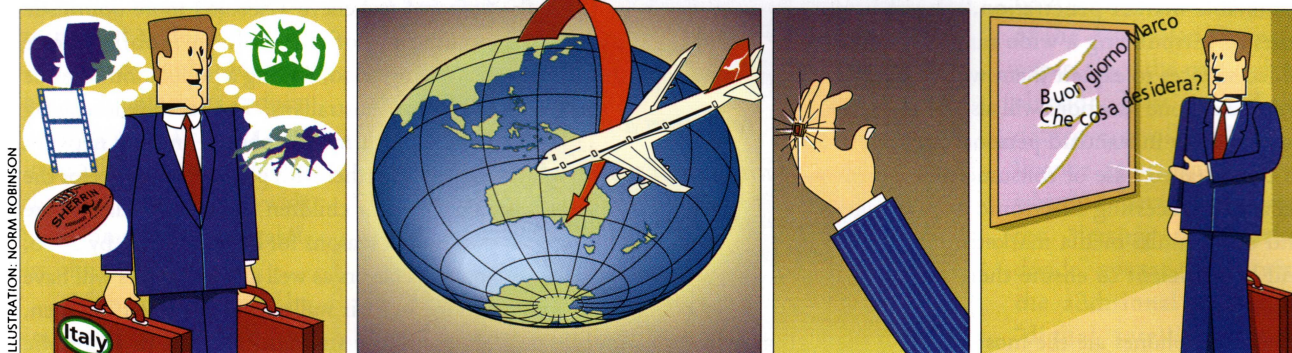
"For the first time since the invention of automatic telephony, telephone numbers will be used to direct calls to an individual user rather than to a piece of equipment."

For the first time since the invention of automatic telephony in 1880, telephone numbers will be used to direct calls to an individual user rather than to a piece of equipment. The telecommunications regulator AUSTEL has allocated the 17-code (17 to be followed by eight digits) for UPT services. The code will support up to 100 million individual UPT numbers. Some early enthusiasts for UPT conceived individuals being allocated a single telephone number for life; it is now recognised

that human beings are much more sophisticated in their needs and may require separate UPT numbers for business and private use.

A mechanism is required for the user to identify him or herself to the network. Initially this can be done by dialling three numbers: an access code to the service provider (a company which might be quite remote and distinct from the network carrier providing the local telephone service); a personal identification code (PIN), just as with automatic teller machines; and then the user's own ten-digit UPT number. Dialling such a long set of numbers – perhaps 20 or more – is tedious and prone to error, and the service providers have been pushing to establish new international standards to support smarter access devices for the mass market.

If Marco Polo visited Australia in the year 2001, what telecommunication services would he use?



Marco Polo as keen a tourist as his eponymous ancestor, is attracted to the prospect of visiting Melbourne's non-stop Comedy-Opera-Tennis-Racing-Busking-Moomba-Cinema-Multicultural-footy festivals...

...After a flight from Beijing to Adelaide, he catches the Very Fast Train to Melbourne and books into the Alitalia Hyatt...

...registering himself with the same 'smart card' signet ring he used to gain access to his air sleeper flight and his train carriage.

Once he has identified himself in similar manner to his hotel room, it turns on the high definition video wall, and asks him in well-synthesised Venetian dialect what services he desires...

At present the major European and North American carriers and equipment suppliers are divided between the merits of magnetic-swipe technology and microelectronic 'smart cards'. Smart cards contain programmable microcomputers and tiny memories which can store the user's PIN, abbreviated number table and other personal information. The cards can be designed to communicate with the telephone network in its own language – multi-frequency audio tones – and thereby avoid the need to augment telephones with card readers, at additional cost to network operators. Smart cards are now in use in Australia within digital mobile phones to identify users and encrypt the link between user and base station. As such, they provide far higher levels of security than magnetic swipe cards. On the other hand, smart cards cost considerably more than magnetic cards – e.g. \$25 versus \$5. The industry debate continues.

Anyone who has used a telephone credit card is already familiar with a small subset of UPT features – the capability to dial *out* from any phone (in the case of phone cards, from any suitable payphone) on a co-operating network. UPT offers the ability to also receive, or divert, *incoming* calls from any phone on a co-operating network. Incoming calls can be diverted to other specific numbers, including network-based voice-mail or answering services, depending upon factors such as time of day, day of year, and the incoming telephone number (including other UPT numbers).

It will be interesting to see who introduces UPT services first in Australia – Telecom, Optus or a local value-adding service provider. Another possibility would be an overseas-based company, who could provide the 17-code services remotely, treating the whole Australian network as a 'dumb' access network. The international network will become

highly transparent, as new network technologies permit human operators and databases to be located wherever they are most cost-effective to the service provider. For example, the entrepreneurial Sydney-based company Matrix Telecommunications uses a pool of telephonists in Manila to transmit incoming pager messages to its pager-using clients in several cities across Asia, without the callers being aware their calls have left their own country.

UPT is but one of several burgeoning 'intelligent network' services, a term used to describe any call-based service which interrogates a database to decide how to progress each call, according to customer preferences. The 'intelligence' of the network is manifested in three ways: in centralised databases called service control points (SCPs); in the telephone exchange software which determines when to pass a call to an SCP; and in the versatility and speed of the signalling system interconnecting all these decision points.

BY 2001, MOST TELEPHONE SETS WILL HAVE SCREENS to display incoming and outgoing numbers and names, enabling the ordinary user to exploit the power of network-based electronic directory services, currently the preserve of hi-tech corporations. Mobile phones, modern payphones, 'premium' phones and pagers have used screens for years, but – until recently – there have been no standards to support electronic network-to-user signalling between a telephone handset and the public telephone network. The development last year of the necessary network interface standards by the influential American standards setter Bellcore will enable cheap, screen-based telephones to become increasingly common products over the next seven years.

Once these screen-based phones have a reasonable market penetration, the per-user costs of introducing a wide range of value-added services to exploit them will be low. By 2001, telephone functions will also be incorporated cheaply in standard personal computers, so the installed base of consumer equipment capable of accessing Electronic Yellow Pages and other multi-media marketing databases will be sufficient to ensure their widespread availability.

Mobile phones are the most visible of the high-growth telecommunication services, though in terms of total volume of calls or revenue they lag the less visible intelligent network services in Australia and the USA. Interestingly, Telecom's mobile marketers confess to having consistently underestimated the future growth of mobile services every year since their introduction in 1986. In hindsight, marketers acknowledge the take-up of mobile phones by self-employed tradespeople as being the most underestimated market sector of the 1980s. Total use of mobile telephone services in Australia over Telecom's analogue MobileNet reached 920,000 paying customers in December 1993 and, including those services resold by Optus, is expected to reach one million in April 1994.

Take-up of mobile services in Australia has been among

"Telecom has connected most of its capital city exchanges with optical fibre, and is pushing out to within a few hundreds of metres of homes in metropolitan suburbs."

the fastest in the world and I, for one, am prepared to believe Telecom's more optimistic predictions of five million mobile phone services by 2000, serving a population of some 19 million Australians. The rapidly decreasing costs of both mobile phones and the network charges, together with parental concerns for the safety of their children and elderly relatives are two potent reasons for believing that, by 2000, many teenagers as well as most adults will have

a tiny mobile phone in their wallet, belt or pocket. By then, mobile phones should be standard features in all public transport and premium cars.

Sadly for the networks' investors, sales of the newer digital mobile phones have been dismal in Australia – less than 1000 genuine paying customers since the licensed mobile carriers Telecom, Optus and Vodafone introduced their 'global special mobile communication' digital networks last year. At present, the sole reason for buying digital is security from eavesdropping. Until the digital networks can come up with superior features – such as screen-based messaging – and equivalent geographical coverage to the analogue MobileNet, together with lower cost handsets, they are unlikely to achieve enough sales.

In 1995, low earth-orbit satellites (LEOs) will be introduced in our region. They will be capable of supporting

Confident predictions for the early 21st Century

- Basic telephone services, taken for granted among the employed in the West, will extend to the burgeoning middle-classes in the rest of the world.
- Cheap radio paging services for incoming messages, combined with public and private payphones for outgoing calls, will extend telecommunications and enhance trade between the rural areas and cities of the most populous developing countries.
- Electronic mail, currently mostly the preserve of the research community and hi-tech corporations, will become available to the affluent masses through the evolution of cheap, versatile hand-held digital personal assistants.
- Screen-based phones and telephony-enhanced computers will promote the widespread use of electronic directory services and electronic messaging.
- 'Voice dialling' will become the norm for all personal telephones and personal computers – although this will not eliminate the need for keypads or keyboards.

Less confident predictions

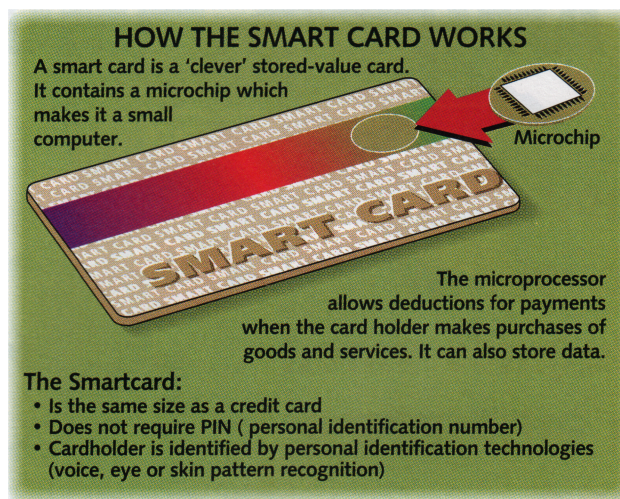
- Video stores will be rendered obsolete by the linking of television sets via telecommunication networks to dial-up video databases.
- Mobile phone networks will improve in quality and capacity to the point where payphones will become standard facilities in all public transport vehicles and luxury cars.
- Electronic directory systems will largely supersede the distribution of paper-based telephone directories.
- The wireline Customer Access Network, currently mostly based on copper pair cabling and electronic signal processing, will become largely superseded by optical fibre and light-based signal processing by the year 2020.

paggers and mobile phones in competition to the current terrestrial 'cellular' mobile services. By 1998, Motorola hopes to launch its Iridium network of 66 LEOs (11 each in six elliptical orbits around the earth), and thus provide truly international portability of mobile services.

Often underestimated by industry watchers is the continuing growth in pager services, in both developed and developing countries. In developing countries to our north, where penetration of wireline telephone services is typically less than 5% of population, small businesses can cost-effectively combine a pager for incoming messages with use of a payphone for outgoing calls. In developed countries, many business people tend to keep their mobile phones switched on only when they need to make outgoing calls, and they too use pagers for incoming messages.

Over the next few years, we will see a convergence of technology between pagers and hand-held electronic organisers in the form of networked digital personal assistants (DPAs), of which the Apple Newtons are an early example. Several companies have teamed up to develop digital personal assistants capable of two-way electronic messaging via the cellular radio networks as well as directly to personal computers and other DPAs. Sophisticated software modules called 'personal agents' have been trialled to handle the torrent of potential incoming messages in a humanoid sort of way – acting as a secretary, for example, in screening out all but the most urgent messages to you when you're at an important meeting.

The power of intelligent network features to personalise services for individuals, and customise services for corporate use, will be coupled with the mobility of radio-access networks to provide a wide range of wireless 'personal communication services'. But given that individuals as well as corporations will want the flexibility to use both cordless and 'tethered' communications devices, the big goal of industry planners is to offer versatile personal communication services that can also support a range of multi-media and broadband services not currently possible through current mobile radio technologies, all bound together by the databases, signalling systems, and network management features of the intelligent network.



Broadband services have been rarely off the front pages of the Australian financial papers since the past Federal election. First we had the controversy of the Pay-TV licence selection process, when Canberra's enthusiasm for "letting the market decide" got tangled up with the additional agenda of "digital satellite services first". Since then we have watched the spectacle of the corporate elephants of the telecommunications, enter-

tainment and broadcasting industries lumbering up to mega-consort in order to dominate the future home entertainment industry. More recently, almost a year after its election pledge, the Federal Government has finally set up a Broadband Experts Group to scope the future market for broadband services and thereby identify opportunities for local participants.

Of course broadband means more than Pay TV or multimedia services. The term 'broadband' refers loosely to any service requiring more than one megabit/second in bandwidth to carry information content to or from the user, as distinct from 'narrowband' (up to 64 kilobit/second) or 'wide-band' (between narrowband and broadband).

Earliest demand for broadband network services have come from a niche market, the operational requirements of supercomputing networks.

A second niche market has risen from the demands of specialists in medicine, science and engineering for three-dimensional visualisation aids, at a remote location from the scanning equipment. A third market exists for transmission of high-quality two-dimensional color images for the primary information sector of publishers, newspapers and educational institutions.

But the investors know that the truly profitable market for broadband services is the mass market, and this is expected to be driven by entertainment services. Not just Pay TV – which to the general public connotes the same programs one might see on the free-to-air channels, only six months earlier – but also interactive video retrieval services, also known as 'video dialtone' or 'video on demand' in the industry. These services will permit the enthusiast to access not just the current schedule of films offered over perhaps 100 channels for the

"The real race now is to provide broadband services cost-effectively to peoples' homes and offices – not a super-highway but more of a super-suburban street network."

next fortnight, but to access, for example, that particular Charlie Chaplin movie or documentary he or she craves – possibly from a specialist video database on the other side of the planet. If you think this is going to mean the demise of the corner video store by 2000, I think you're right.

Since the 1950s, the available bandwidth for customer-to-customer switched data services has increased in the Australian network from 300 bits per second to 10 million bits per

second with Telecom's Fastpac service (using QPSX technology developed by the University of WA) in the early 1990s, already an increase of 30,000 times. The Broadband ISDN technologies waiting to be rolled out in the next few years will support switched broadband services at 155 million bits per second, while direct use of fibre-optic technologies between sites will support in excess of 2000 million bits per second

In this context, it is useful to clarify what exactly the much-banded term 'superhighway' really means. In June 1993, Telecom finished connecting all the Australian mainland capitals with optical fibre, and Optus – starting its network construction in only 1991 – plans do the same by 1997. Optus and Telecom have connected fibre to the Central Business Districts and are busy connecting as many hotels and large corporate buildings as possible. So the 'superhighways' are already installed – from suburban exchange to suburban exchange. The real race now is to provide broadband services cost-effectively to peoples' homes and offices – not a super-highway but more of a super-suburban street network.

TELECOM HAS CONNECTED MOST OF ITS CAPITAL CITY exchanges with optical fibre, and is pushing out to within a few hundreds of metres of homes in metropolitan suburbs, to the so-called 'fibre centres'. What does a fibre centre really mean? It means the point from the centre of the network to which it is cost-effective to concentrate several streams of traffic on the same links; and beyond which it is more economical to reticulate the network by individual pairs of copper wire (or coaxial cable) to individual homes. The cost of converting optical signals in the fibres to electromagnetic signals in the wires or cables is significant, and is done more cheaply at a centralised 'fibre centre' than at all the customers' homes serviced by that fibre. For

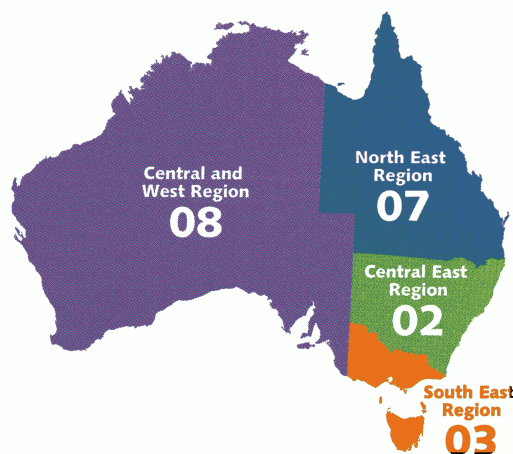


Figure 1: Major changes to Australia's telephone area code regions from late 1998

this reason, among others, I do not envisage the fully optical Customer Access Network – the concept known jocularly as the 'glazed CAN' – will become a reality until well into the next century.

What do these trends mean for Australia? The reputation of Australian consumers for quickly accepting new technology, their relative affluence in international terms, together with low import barriers, will ensure Australia continues to be

used as a marketing test ground by trans-national suppliers of advanced consumer and business communication equipment. As for the future of Australian innovation and local industry participation, the answer will depend on the sophistication of successive Australian governments in recognising the competition they are facing with other regional governments who are unashamedly interventionist in attracting and inducing local manufacturing. Australia's current Partnership for Development (and Fixed Term Agreement) scheme is a smart initiative. The scheme, which capitalises on Australia's excellent tertiary education system, encourages multinationals to set up local R&D groups focused on export opportunities. But it is under threat from the US, which is determined to wipe out all barriers to its own telecommunication and IT vendors.

From the vantage point of 2001, the 1980s may be looked back upon as a peak of Australian innovation in telecommunications: the introduction of solar-powered digital radio telephony in the outback; the early and commercially successful introduction of advanced ISDN services and ISDN customer equipment on a national scale; the local development of high-speed data network services (based upon QPSX technology) and innovative intelligent network services; the local development of advanced touchphones as the standard consumer telephone – all a significant boost for local industry, and all leading to export sales.

An encouraging trend of the early 1990s has been the success of Australia-based suppliers in the export market – not just the larger firms such as Alcatel, Ericsson, Siemens

and Pacific Dunlop, who have had major successes in selling into Asia – but also the small to medium size companies such as Datacraft, Jtec, Matrix and Stanilite. All these firms are winning export business in competition with the best telecommunication firms in the world.

★

"By 2000, many teenagers as well as most adults will have a tiny mobile phone in their wallet, belt or pocket."

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For some time yet, much of our telecommunicating will continue to depend on the existing web of thin copper wires that telephonically link most of our homes and workplaces. Making it possible for that network to match the communications demands of the near future will require new technologies that widen the lanes on the information highway.

THE STANDARD TELEPHONE service is something we take for granted in today's modern world. The public telecommunications network provides a reliable and widely accessible service – we have high expectations and react strongly when the service is unavailable. To meet the demand for high reliability, and to provide services economically, the public network is being progressively upgraded.

Yet consumers are still waiting for the widespread use of new services such as the video phone, which was first demonstrated 30 years ago. What then is required to make new services such as video telecommunications possible and widely available? Apart from the availability of inexpensive video terminal equipment, the key requirement is increased bandwidth (that is, more available frequencies for transmission) which must be provided by the network at an affordable cost. Understanding how this objective might be achieved requires a review of the existing telecommunications network and the new technologies that are expected to improve and extend its capacity.

The traditional telephone network consists of a pair of copper wires connecting the customer premises to a local exchange. This is known as the customer access network.

The local exchange is connected to other local exchanges through a series of intermediate exchanges, using

coaxial cable, microwave, or satellite transmission links. This part of the network is referred to as the core network. Within the core network, a technique known as multiplexing is used so only a small number of physical connections are needed between each telephone exchange. As a result, each transmission link may carry thousands of telephone conversations simultaneously.

Traditionally the telephone network used analogue switching and transmission techniques. Since the 1970s, the core network has been progressively changed from an analogue to a digital network. Telecom currently plans to have a full digital network by 1999. Digital technology offers better quality, with the capability to accurately regenerate the original transmitted signal even when buried in unwanted noise. Pulse Code Modulation (PCM) is the process in which the analogue telephone signal is converted to a digital one. Each analogue voice signal is sampled at a rate of 8000 times a second, with one sample represented by eight bits of digital information. Each voice signal therefore requires a 64 kilobits/second transmission channel.

The physical connections in the core network have in recent

years been changed to fibre optic cable. Australia now has a large fibre optic network connecting major metropolitan centres. Fibre optic cable is fundamentally the most important transmission technology because of the high bandwidth that it offers.

The shift from the analogue to digital world within the core network means that a majority of local exchanges in Australia are now digital exchanges. What then of the customer access network? A long term goal is to upgrade the customer access network using fibre optic cable, which will allow the delivery of new high bandwidth services such as video-on-demand. However, this final step from the local exchange to the customer is an expensive one, due to the large number of connections involved. Only when the demand for these new services is well established can the cost of large scale deployment of fibre optic cable in the customer network be justified.

The mobile phone represents another type of customer access network. Mobile units communicate with base stations, which in turn connect into the core network. In the future an increasing proportion of the radio spectrum will be required for mobile telecommunications. Fibre optic cable permits high bandwidth services that do not inherently require radio transmission, such as broadcast television, to be removed from the radio spectrum.

Before fibre optic cables are widespread in the customer access

network, new technologies will be applied so higher bandwidths can be provided using the existing copper pairs."

applied so higher bandwidths can be provided using the existing copper pairs.

The Integrated Services Digital Network (ISDN) is one such example. (ISDN is also referred to as narrow-band ISDN to contrast it with B-ISDN – see below.) ISDN brings a digital connection from the local exchange to the

customer premises using existing copper wire pairs. It provides two 64 kilobits/second channels plus a 16 kilobits/second signalling channel in each direction. To the user this appears as a doubling of the previously available bandwidth, plus increased signalling. The main advantage of ISDN might be in support of services such as computer networks that require full digital connectivity.

Another new technology is Asymmetrical Digital Subscriber Line (ADSL) technology, which may be a cost effective way to deliver new high bandwidth services to the home. Like ISDN, ADSL uses the existing copper pair. While standards are not yet complete, ADSL is likely to carry up to four 1.5 megabits/second channels in the direction of the exchange to the customer. A transmission rate of 1.5 megabits/second corresponds approximately to coded video at VCR quality.

A likely early service that will take advantage of ADSL will be video-on-demand. This offers the user VCR-like functionality in viewing pre-recorded programs without having to go to a video store; the user simply selects the desired program from the comfort of home.

ANOTHER interim solution might be "fibre-to-the-curb", which involves partial re-cabling of the customer access network. Fibre optic cable is laid from the exchange to a street mounted enclosure. ADSL and the existing copper pair, or coaxial cable, are used in the final path or connection to the customer's premises.

"The next evolutionary step in public networks will be the Broadband-ISDN, which aims to carry all types of broadcast and interactive services, including video, audio, and data services on one network."



Fast packets: An experimental Asynchronous Transfer Mode (ATM) switch is used by a Telecom researcher to transmit high-resolution images at very high speeds.

The current telecommunications network has been optimised for voice communications. It is inflexible because it isn't able to offer a very wide range of bit rates. To reliably carry computer data, dedicated networks are often used. Network management is thus complicated by having to independently manage individual network types. To deal with these problems, the next evolutionary step in public networks will be the Broadband-ISDN, which aims to carry all types of broadcast and interactive services, including video, audio, and data services, in a flexible and efficient manner, on one network.

A fundamental technology required by B-ISDN is Asynchronous Transfer Mode (ATM). In ATM, user data are placed in small fixed length packets, called cells, to which a header containing address information is attached. By reading the address

in each cell header, ATM switches direct the cells sent from a sending terminal to the correct receiving terminal. The ATM cell structure is very simple, which minimises the amount of processing that must be performed at each ATM switch, and thus allows very high transmission rates. The path through the ATM network is actually established at the start of each call. The network ensures there is adequate capacity on each link in the network to support the new call. ATM is service independent in that the network reads only the cell header, and not the cell user data.

B-ISDN is based upon a standard 155 megabits/second fibre optic connection between the customer and the first ATM exchange.

The International Telecommunications Union (ITU), a part of the United Nations, manages the B-ISDN standards for public communications. However, within the Local Area Networking (LAN) environment there is also great interest in using ATM. ATM switches for LANs are now commercially available. Activities in this area are focused within the ATM Forum, which is an informal group of companies, many of whom have traditionally been involved in LAN technology. The LAN environment provides a convenient test area for ATM technology, before deployment in public B-ISDN networks.

In Australia, Telecom has plans for an experimental B-ISDN. The service is expected to be available in late 1994/early 1995, with ATM switches located in Melbourne, Canberra, Sydney, and Brisbane, and later Adelaide. The objective of the experimental network is to gain early ATM experience, and foster new applications and alliances. Due to the large costs of such a network it could be expected that it will be some time before a commercial B-ISDN service is available.

The compact medium

They've largely replaced the turntable and audio tape player, now compact discs look set to supersede most of your home video equipment. Manufacturers are beginning a new 'format war' that promises to transform CDs into the preferred medium for the huge home entertainment and education market. The problem for consumers is deciding which technology is likely to dominate.

THE COMPACT DISC (CD) IS touted as the medium that will encompass all media that have come before it – print, video, text and audio. Given the magnitude of the claims made on its behalf, it is perhaps surprising that people understand little about how CDs work, what their limitations are, and how we can expect to see them being used in the next five to 10 years.

The data on a CD is a spiralling trail of more than 600 million million ones and zeroes nearly five kilometres long and one hundredth the thickness of a human hair. Seen in this perspective, the computer's task of locating and retrieving CD data makes looking for a needle in a haystack seem ridiculously easy.

The laser in your CD player shines light on the shiny substrate of the CD, through a clear protective layer. This

substrate has tiny pits which scatter the laser light, and flat areas which reflect the light. These reflective and scattering areas (which give the CD its distinctive rainbow quality) are read as 0's or 1's by a light sensor, and are the digital data which constitute your favourite Frank Sinatra album or Encyclopaedia CD Rom. The discs are mass produced by injection moulding.

Since the number of zeroes and ones which can be squeezed into one revolution of a compact disc gets smaller as you move closer to the centre of the disc, the CD drive must constantly and smoothly adjust its speed to keep the data stream moving at a uniform rate. The drive must find the right bit at the right speed (see Figure 1). Vinyl records, hard drives and other disc media solve this problem by spacing data further apart toward the perimeter of the disc, where the circumference is greatest, so they can spin at a constant speed. But the compact disc format was originally designed for audio – that is, sound reproduction – where a drive generally need do no more searching than finding the beginning of the next Frank Sinatra favourite, so the engineers at Philips decided to pack as much playing time as possible onto the disc by spacing the data evenly throughout.

Decisions about the compact disc format were made on the basis of delivering good-quality audio – the original specification for CD is known as "red book audio". But we now expect CDs to deliver a lot more than just audio, and yet while still basically keeping to the same standard. As a result of this and other factors, the key characteristic of the compact disc as far as non-audio uses goes is perhaps best summarised as "great storage medium, lousy input/output".

Most non-audio CD players can retrieve up to 150 thousand (150 K) bytes of data per second from a standard CD.

More recent double speed drives can read at 300K per second, which is still more than 10 times slower than a good hard drive in a personal

computer. As quad and triple speed CD drives become more common, these speeds will continue to improve, but don't expect miracles. This low retrieval rate explains why much of the technical dialogue on compact discs revolves around data compression. If the data on the disc is compressed enough, it can be "squeezed" through the bottleneck.

Compression is the key to unlocking the much-hyped potential of the compact disc to contain all other media and recent advances such as the ability to play video and sound concurrently from a normal CD. The same compression technologies will allow us to squeeze services such as video-on-demand to homes through ordinary telephone lines, and already let us transmit photographs easily around the world.

Although the CD's circular shape enforces certain limitations on us, it is also the compact disc's main strength and the secret to its likely longevity. The shape of the CD permits non-linear data access – that is, unlike a tape, which is essentially a long line of data, the CD allows us to skip around at will, and find data fairly quickly.

For the user, this translates into interactivity – the potential to make choices and change the relationship with the content, creating in effect the difference between a long, boring lecture and a lively conversation.

For example, consider movies, which we are used to viewing in a linear way. The stories told to us on film have a fixed beginning, middle and end.

However, if that information is transferred to a non-linear medium like a CD, we have the potential technically to make choices about what happens. This characteristic is known as branching. Since we can now fit an entire film with stereo sound on a single CD, it's possible to include a selection of storylines, sub-plots and documentary

"Compression is the key to unlocking the much-hyped potential of the compact disc."

material which would allow the viewer to choose a different character's point of view in a scene, or skip to an interview with the director.

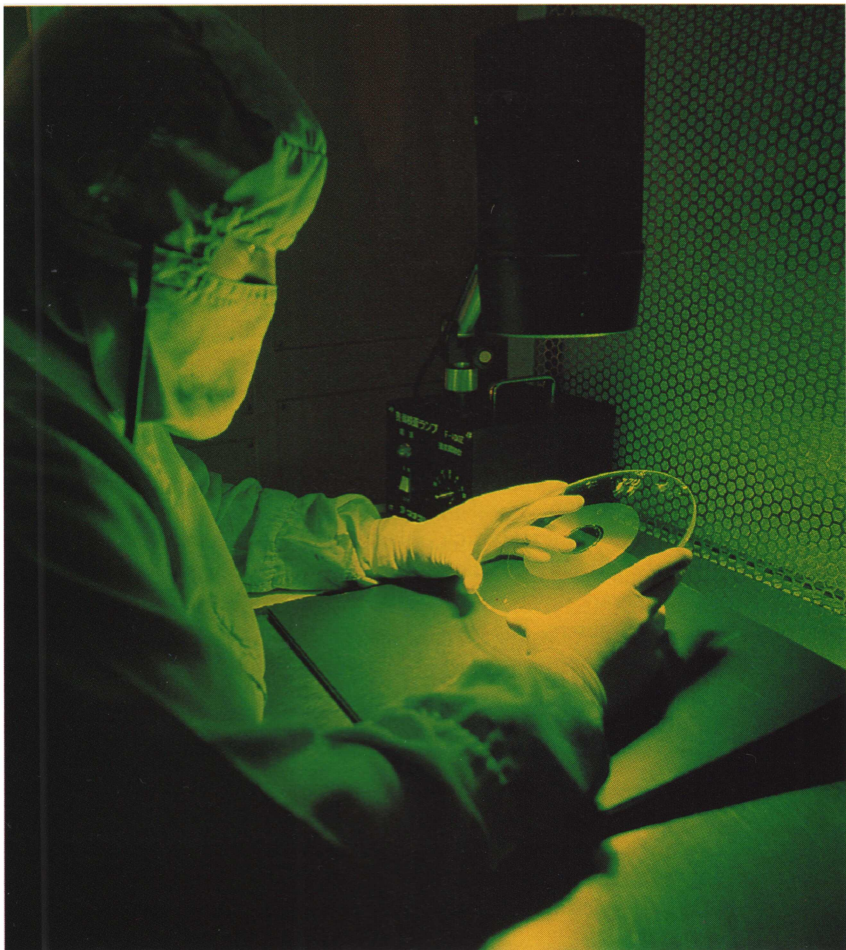


PHOTO: DISC TRONICS TECHNOLOGIES

CD manufacturing: 27 million sold in Australia last year.

The non-linear aspect of the CD medium explains why some of the first non-audio CD products were encyclopaedias and reference works. Users can zero in quickly on information they need, and can jump easily and intuitively from topic to topic.

ROUGHLY SPEAKING, NON-AUDIO CDs divide into two camps: the CD Rom formats and all the rest. The distinction here is that CD Rom is the standard for computer-based CD systems. The other formats, such as CD-I, 3DO, Video CD, CD 32, Nimbus, the new Jaguar and Sega's Mega CD, are aimed at consumers and can be used only on proprietary players that generally plug into your television set in much the same way that your video cassette recorder does now. In almost all cases, discs from one system

do not fully work in any other system's player, although some can be played without interactivity. For example, Kodak's Photo CD product range is readable by CD Rom drives and many consumer players.

CD Rom is an international standard for compact disc computer media – the letters stand for “Compact Disc Read Only Memory”, meaning that the computer can read the data stored on it, but not write to it. The computer treats a CD Rom just like a super-large locked floppy disc. The fact that CD Roms are designed for use with computers means that not all CD Roms are playable in all computers. Some discs are playable only on a Macintosh, others only on an IBM-compatible PC, others in Unix environments. Some discs can play in several environments.

More recently, recordable compact

disc or CD-R technologies have been developed, which have enabled products like Kodak's Photo CD and other exciting applications. Don't confuse the CD-R process with the mass replication of CDs. CD-R allows us to make “one-off” or short-run CDs by a quite different process, but one which is at present much more expensive. The media alone for creating a single CD-R disc costs around \$40 in Australia, as compared to around \$2 per disc for 1000 pressed CDs.

In the CD-R process, a laser beam heats a dye layer adjacent to the (usually gold-colored) reflective layer, making a non-reflective “spot” which serves the same function as the moulded pit of the pressed CD. By this process, any data can be stored on the disc, including audio. CD-Rs can hold 63 or 74 minutes' worth, depending on the recordable area of the disc.

In the last year, prices of CD-R writers have dropped enormously, and the cheapest, the Pinnacle CD Writer, is now available for \$US2,225. CD-R discs are less durable than pressed CDs, and should be kept in dark, cool environments.

Kodak's Photo CD is a family of CD-R products. Kodak has long been the “Yellow Tollbooth” of the graphics industry: their chemicals and hardware permeate every stage of image production from the film stock for happy snaps right through to the printing press. Everyone who goes down the graphics road inevitably pays Kodak at some point. With the digital age upon us, Kodak needed some way to keep the tollbooth ticking over in the radically changed landscape of digital publishing. Enter Photo CD.

Kodak took the principle of the film laboratory and applied it to CDs. The concept is: you take your 35mm film to them (developed or undeveloped, transparency or negative but not prints), and you get back a CD with your pictures on it, for about \$2 an image. A standard Photo CD can fit up to 150 images. Only Kodak equipment can write Kodak Photo CDs, and Kodak Photo CDs can only be made on badged

Kodak stock. Photo CDs are not pressed discs. They can be played on a wide range of consumer and CD Rom drives, and this may provide their main staying power in the marketplace. Each new consumer format seems to be including Photo CD ability.

Of course, anyone with a scanner and a CD-R writer can put their images on a CD, but Kodak have streamlined the process to a point where it is very efficient. At a Photo CD workstation, a trained operator can put 140 images an hour onto CDs.

One of the neat tricks about the Photo CD format is that each scanned image on the disc is kept in five resolutions, within a single file. Kodak calls this single encompassing file an image pack. The smallest image pack resolution produces a passport-photo sized image (a "thumbnail"), and the largest

would be adequate for a largish color reproduction. The resolutions in between are intended for home television display and happy snaps.

The current non-audio CD market mirrors the state of the immature consumer video market of more than a decade ago. We are in the middle of a "format war" akin to the Beta/VHS video battle. That war dogged video manufacturers for 15 years. Only recently, after the VHS standard had won out, did the video market mature and grow, accompanied by price falls and high market penetration.

Almost all CD products which currently fit into the consumer market are CD Roms, which are designed for use with personal computers. The only exceptions so far are the Sega Mega CD

"The CD Rom drive market has grown a staggering 600 percent in the last two years."

game system (which, incidentally, sold out within days of its arrival), and the CD-32 multimedia system.

But in 1994 we will see the introduction of Philips' CD-I product, with others close behind such as Jaguar, Nimbus and 3DO, all of which use a proprietary box linked to the television set. These represent the first serious attempt at mass-market multimedia. All these formats will be capable of playing entire movies with stereo sound from a single CD, and more.

What predictions can we safely make about the consumer market for non-audio CDs? Mass markets for new technology follow well-documented paths. When a new product is released, the gadget freaks or early adopters are the first on the scene. Early adopters – typically technologically literate,

How to talk CD-speak

THE CD MARKET IS A L.O.C.A.S. (Lots Of Confusing Acronyms and Standards) environment. As the engineers wryly put it, the nice thing about standards is that there are so many to choose from. Nowhere is this more true than in the non-audio CD arena.

Here is a short list and explanation of the more commonly-used terms and standards:

CD-Bridge Disc

A disc that can be played on both a CD-I player connected to a TV set and on a CD Rom player connected to a computer. An example of a CD-bridge disc is the new Photo-CD disc. The Photo-CD disc will be playable in CD-I players, Kodak's Photo CD players and in computers using CD Rom/XA drives.

Green Book

The format standard for Philips's Compact Disc-Interactive (CD-I) discs and players.

ISO 9660

ISO stands for International Standards Organisation, which is the highest international authority for standards. ISO 9660 has emerged as the standard for organising a CD Rom that can be played back on most computer platforms. The basic question to ask when talking about CD Roms is "Is it ISO 9660?"

Mixed-Mode CD-ROM

These are mixed-mode audio/data discs in which the first track contains computer data and the remaining tracks consist of digital audio. This scheme has been successful in products that integrate inter-

active front ends with CD-quality audio, such as Voyager's I Photograph to Remember, and the new interactive U2 album, Zooropa. It will become increasingly common for you to put a CD into your player and see the CD player display something like "Track 0", and then skip on to the first music track. This is Mixed-Mode. Track 0 is actually data. It might be video interviews with the musicians, or liner notes, or some other form of inter activity added to the CD. You need a CD Rom drive to access the extra bit.

MOD

Stands for "Magneto-Optical Drive", which is a rewritable storage device, where the reflectivity of the spots on the medium is controlled by magnetic fields, rather than by dye or pits.

Multi-session

The directory on a CD, which tells the computer or CD player where all the data is located, is written at the start of the disc. With CD-R products, however, data might be written to the disc in several separate sessions, leaving the directory data written at the beginning of the disc unchanged and incomplete. For example, say you took your film down to the local Kodak Photo CD facility and had 36 pictures written to disc. When you take the disc back with a second roll of film, to add those on to your disc, the CD-R drive can't write over the directory so that it will reflect the added information on the disc. Given that a single Photo-CD can hold 150 images, this is obviously a big problem for you. Multi-session drives

*"The current non-audio
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middle-to-high income males – find new technology sexy. These nerdy early adopters make any new product's initial push into the marketplace possible by being the "first on the block" to own the new product, often becoming evangelists and converting others.

The early adopters made it possible for Apple Computer to survive after the launch of the Macintosh. Apple use early adopters to finance each new product, and their recent Newton MessagePad product was aimed squarely at this group once again.

The marketing battle over non-audio CDs, already underway in Europe and the US, will begin in earnest here soon when the first CD-I players hit retail outlets and begin to shape the

market for the foreseeable future.

After a format war, markets ranging from corporate to consumer tend to balloon out. As buyers gain confidence

in a format and buy in volume, large runs of components make lower prices possible, and entertainment/software giants such as Warner Brothers will begin to really commit to the winning format. We can expect the non-audio CD market to follow this pattern.

When the ferocious hype surrounding multimedia comes to fruition, the early adopters will be out in force. After an initial rush, the market will settle down as the war drags on. Sales will not reach levels comparable to the current VCR market until consumers feel comfortable that they are not buying

obsolescence. Full consumer market penetration on a scale of the VCR may be as far as 10 years away.

Among computer users, CD sales are already booming. Last year there were approximately 200,000 CD Roms sold in Australia, which is a healthy enough figure. This compares to more than 27 million audio compact discs sold during the same period. Sales of CD Rom drives (they're computer peripherals, remember, not consumer machines) have been ballooning in the last two years. The CD Rom drive market has grown a staggering 600 percent in the last two years. The value of CD Rom sales (discs) increased in a single year (1991 to 1992) from \$6.8 million to \$34.6 million. Sales for 1993 have been estimated by a domestic consultant group at \$107.9 million. CD Rom disc prices for the end user are expected to fall steadily over the

know to search all over the disc for directories, and each session can have its own directory. Philips CD-I system can read multi-session discs, as will most of the other emerging home systems.

Orange Book

An addition to the Yellow Book format (qv.) which covers writable CDs, including CD-Recordable, magneto-optical cartridge systems and Kodak Photo CD. Almost all CD-R devices conform to the Orange Book standard.

Red Book

The first compact disc format, which describes the encoding of digital audio information on CDs. The audio CDs that you own are technically in Red Book format, which is why you can play them in any audio CD player. The CD on the

Voyager spacecraft now in interstellar space was Red Book audio.

White Book

A new video format established by Philips, Sony, JVC and Matsushita for karaoke CDs. The company hope White Book will also be used for books, movies, music videos and training programs. A disc conforming to White Book will be playable on a wide range of CD players, including Video CD, CD-I, CD Rom drives and audio CD players with decoding boxes or cards.

WORM

Stands for "Write Once, Read Many". This is an optical format used in large storage or archiving systems. Two-sided, 12-inch discs in this format can store over 10 Gigabytes (10,000 megabytes) of infor-

mation on each disc. A laser burns pits into a reflective alloy layer. Since it was designed as a storage medium, rather than for audio, even the slowest WORM drives have more than double the throughput of a CD drive. Worm discs are often used in jukeboxes, which can handle many of them at a time.

XA

Stands for "eXtended Architecture". This is a method which allows compressed audio to be "interleaved" with other data. In other words, each chunk of data read by the CD drive (these are called blocks) can contain sound and, say, text, or video, and they can all run concurrently, rather than the drive having to use separate tracks for these purposes, as in mixed-mode (qv.). XA allows for three qual-

ity levels of audio, from full fidelity down to AM radio-standard. The lower-fidelity sound takes up much less space so, with a compromise in quality, it's possible to double the playing time and have text or animation happening at the same time. XA frees up space on the disc by relaxing the built-in error correction test used on straight CD Rom and Red Book(qv.) audio discs. Most CD Rom drives now being released can do XA, but it's worth checking, because without this capability, the flexibility factor drops considerably.

Yellow Book

The Yellow Book format is the basis of the computer-based CD-ROM, introduced in 1989. It includes Modes 1 and 2, which pretty much means XA (mode 2) and non-XA (mode 1). See XA above.

next two years as economies of scale come into play.

Multimedia CD Roms were listed as the single biggest driver of the growing market. A British report in 1993 listed 2,271 multimedia CD Rom titles worldwide, with projections to reach soon. The US produced 62 percent of these titles, Europe 28 percent, and Australia a mere 2 percent. Current CD Rom titles range from products detailing the meaning of life (courtesy of the Church of Jesus Christ of Latter Day Saints), to interactive rock CDs by Motley Crue.

The fastest growing areas of CD Rom publishing in 1992 were education and training, language courses and linguistics, transportation, agriculture, the life sciences, the arts and humanities, and legal publishing.

If all this sounds pretty good, remember this is all just computer software. Compared to the video games market, let alone the home video market, where products like 3DO and CD-I will be competing, it's small change. Non-audio CD technology has spent its childhood in computer land, but it will grow up in the home.

Among the emergent CD products, the first was Philips's CD-I (Compact Disc- Interactive) system. Philips has an impressive background as a standard-setter in consumer electronics, having created both the successful compact disc and compact cassette formats. CD-I was produced at the company's Eindhoven works in 1985 and launched as a joint effort with Sony and Matsushita as the definitive standard for consumer multimedia. The CD-I format is already eight years old, and to date not a single player has been sold through normal retail outlets in Australia. The launch here is scheduled for early 1994.

The CD-I format is not aimed at the computer market. It is a consumer product, aimed at families, preferably with pre-teen children, who have enough disposable income to afford to spend around \$1000 on a home entertainment and

education system. Philips claims to have sold over a million CD-I titles in the US and Europe.

CD-I discs play back through a normal television set or a liquid crystal display (LCD) screen in a battery-powered hand-held unit. A remote-control thumb-operated joystick controls an on-screen cursor. While this consumer market is potentially much larger than the computer market, bear in mind that 87 percent of white collar workers in Australia already own or have access to a computer, and that there is already an installed base of more than 180,000 computer CD drives in Australia.

The CD-I format allows for a range of CD products, from interactive books and presentations to full motion video (FMV), with CD-quality sound. CD-I players will also be able to display Photo CD images on your home television set, but it looks like most of the emerging players will be capable of that, too.

CD-I is already starting to look a little long in the tooth, and there is a perception that Philips may have left their run too late. One huge problem is that CD-I is a very closed hardware format, rather than an open architecture that can easily grow to meet changing times. The 1 megabyte of memory CD-I has to work with must have seemed like a lot eight years ago, but many developers working with CD-I find it extremely limiting, especially for games, which must be the key to the success of future products in this field.

Another problem has arisen now that compression makes it possible to play 94 minutes of full motion video with quality audio, right off a CD. FMV is achieved by compressing the video and audio. All

"Non-audio CD technology has spent its childhood in computer land, but it will grow up in the home."

emerging consumer formats will be capable of FMV.

CD-I needed to be changed for FMV, even before it had been released here. Now users who wish to watch videos on their

"The CD Rom drive market has grown a staggering 600 percent in the last two years."

CD-I players need to buy extra hardware to do it, and buyers looking at CD-I will be faced with two options: with or without

video capability.

Paramount has already committed the company to releasing 50 of its movies in a CD-I format. That's not a big commitment to the format, and amounts to no more than a tentative punt on one of the players.

Tellingly, co-developers Sony and Matsushita have already effectively pulled the plug on CD-I. Neither company will be producing CD-I players for the consumer market. This is a heavy blow for Philips. However, unless CD-I is an early knockout, we should expect manufacturers to change alliances often as fortunes change in the format war.

In the US, Philips has countered industry rumors that the company was losing enthusiasm by producing glitzy commercials and even an "infomercial" promoting the CD-I player and its video add-on box.

Overall, however, CD-I is beginning to look like a lost opportunity for Philips in the home market, although as an audio-visual player for information kiosks and presentations, it is still a powerful tool, probably the best.

The multimedia product creating the greatest level of interest is 3DO. The first units appeared on the shelves in the US late last year. The 3DO company has a quintessential 90s savvy, and a radically different approach to that of Philips. 3DO does not make hardware – the product is a licensed format, the broad details of which are freely available. So far (remember, it's only been on the shelves for a couple of months), 302 developers have signed up to produce CD titles, 92 of which are already in development. This includes the spin-off game for the movie *Jurassic Park* and other serious money-spinners.

The film director Steven Spielberg called it "the breakthrough of breakthroughs", and it was his early confidence in the product which helped convince Matsushita to allow MCA on board, even though it meant aligning

with a major competitor, Time Warner. 3DO has been the darling of the entertainment industry since its inception and its chief executive, Trip Hawkins, has been busy promoting the company all over Hollywood.

The first 3DO boxes are being made by Matsushita under their Panasonic brand, but Sanyo and AT&T have already shown their version. Other manufacturers will be watching closely, balancing the need to conserve resources by staying out of a costly format war with the desire not to be left behind.

As the name suggests, 3DO is very good at three-dimensional representation. The company sees the initial market as games-based, rather than audio-visual as Philips did, and to this end 3DO is a fearsome games machine, with the ability to display millions of polygons per second (3D images are made up of many tiny polygons). It will also play audio CDs and Photo CDs. The next version will also play movies, as Philips CD-I does now. So far there is a

fairly disappointing list of titles, but with so many developers signed up, that won't last for long.

3DO says none of the current developers has begun to take advantage of the real power of the system. Currently, 3DO machines sell for \$US750, but Hawkins expects this to drop to \$US200 by 1995. This prediction depends on what happens with the other CD players. Hawkins will try to offset the high cost of the machine with cheap titles. He is claiming that 3DO titles will sell for as little as \$US15 a throw.

We can also expect to see 3DO in the arcades – they're so good at games that they blitz the current competition in that arena. Even Atari have admitted it, and

are releasing coin-operated 3DO games.

The 3DO box is a clever kind of Trojan horse, and the company has a marketing agenda reaching far beyond the CD market. From the start, it was designed as the core of a digital home-entertainment system. The current Holy Grail for high technology vendors

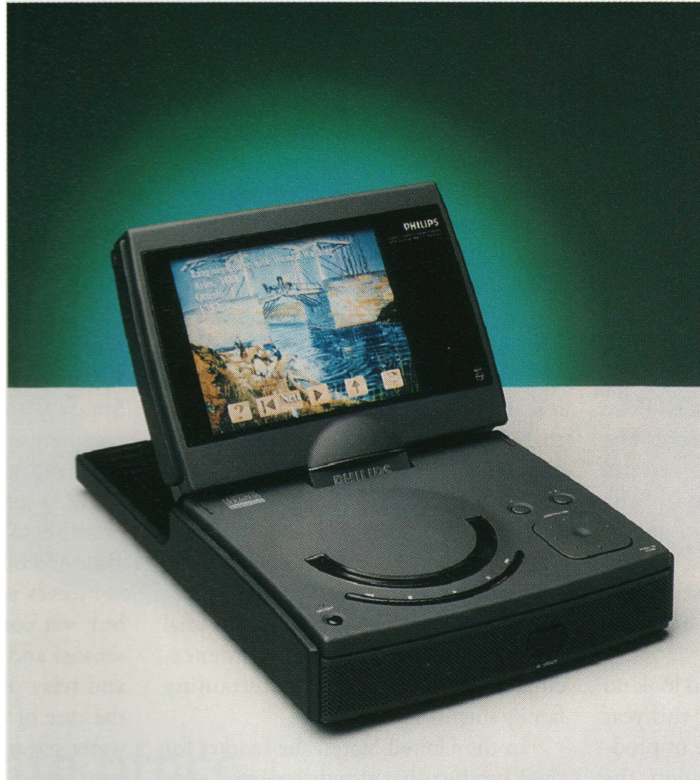
does well, it may become a kind of *de facto* standard for this most lucrative of new industries.

The other emerging products include Video CD, a Philips-registered trademark dating from 1987, and which describes a format for playing video from a CD. Sony, JVC, Matsushita, Commodore, C-Cube and Paramount Pictures were signatories to Video CD. In the same way that we can play audio CDs in any CD player, Philips was hoping everybody would sign up for the Video CD standard, thus making all CD video players compatible. That hasn't been the case. There are currently many competing, incompatible systems for storing and playing video from a compact disc. Video CD is still around, and there is as yet no indication of whether it will be the VHS or the Beta of the next format war.

Amiga's first bid in the CD market is CDTV, which is basically an Amiga computer minus the screen and keyboard. It has not a shadow of a chance of becoming an industry standard.

CD-32 is Commodore's latest foray into the CD-based video game machine market. The base product is not video-capable, but can be made to run video with an add-in card. If it follows the example of CDTV, CD-32 will quickly be available for under \$US400. The product is apparently selling quickly in Europe.

Finally, there's Nimbus, which is an innovative product that so far has had a total lack of support. Nimbus allows you to play videos from an audio CD player. If you have a "digital out" jack from the back of your CD player, you could use Nimbus to watch movies. Nimbus claims that about 30-35% of players have such jacks.



Phillips' CD-I portable player: a consumer product aimed at families with pre-teen children.

in the US is the "set top box", which will bring interactive television and other mass-market digital services into the home. This box will sit on top of your TV, plug into a cable or fibre service and provide you with video-on-demand, home shopping, electronic mail, interactive games and so on. Apple, Silicon Graphics, IBM and Motorola have been tripping over each other to get the contract to make them.

3DO is already there. It is 'cable-ready' – that is, it has the underlying structure, if not the immediate capability to do the kind of work these boxes will need to do. That capability is being developed now, intended for release in 1996. So if 3DO's interactive CD player

The SOHO* scenario

The advances of the computer industry are blurring the distinction between home and office, and appear to be reversing a century long trend of people going from home to work.

THE 20TH CENTURY HAS BEEN A remarkable era for social change, not least of all for the separation of home from workplace, and the emergence of what the social theorists sometimes call 'specialised space'. In Western society 100 years ago, the majority of people worked at home; now, nearly all work is done outside the home – at the office, the factory or the shop.

Today, in the name of various journalistic mnemonics (Smart home, teleworking, the virtual office, etc), we see the makings of a kind of reversal. The rapid rise of the personal computer and associated communications and media technology (CDs, fax, modems, optical fibre, etc) appears to herald a 21st century assault on the modern distinction between home and work, between private life and public role.

For evidence of this we need look no further than the launch earlier this year of the 'Microsoft Home' range of products by the Microsoft Corporation, the world's biggest computer software firm. The company's 'Home' range includes software for multimedia encyclopaedias, interactive movie guides, classical music appreciation, creative writing and publishing kits for children, science education programs, simulated golf games, money management programs, and electronic address books for your friends and social acquaintances. Microsoft has reportedly spent \$100 million on product development for the 'Home' range. Currently 35 products are available, and another 65 are expected within 18 months.

* SOHO stands for Smart Office/Home Office. In some sections of the IT industry, SOHO has come to represent the technological trend towards the convergence of home and workplace.

The marketing strategy behind this splurge of home software is revealed in the slick slogans for the company's 'Home' promotion in Australia. The slogans included lines to emphasise diversity ("It's a great big world in here") power and flexibility ("Do what you want to do"), and conviviality ("Welcome Home!").

If you thought going home was an interruption to your work, or staying home was a bore and a brake on your leisure, Microsoft would like you to think again. Market research by the company suggests that home computers are no longer solely used for playing games or doing the work you should have done at the office. People now apparently want the computer to serve the whole family, maintaining financial records, producing correspondence, educating children, and entertaining family members.

In the United States, the market for these products has already emerged – for example, Americans now prefer to buy a computer with a multimedia encyclopaedia included than a printed set of encyclopaedias. Microsoft hopes to sell 1.6 million multimedia products in 1994.

Multimedia products that do not require computers are also beginning to appear. Philips ("You can Do it All") recently launched its 'compact disc interactive' (CD-I) player and a range of CD titles aimed chiefly at home entertainment and education. The combined video-audio CDs currently available include films, arcade games and puzzles, foreign language courses, and interactive versions of *Sesame Street*, Bible stories, *Aesop's fables*, *Alice in Wonderland*, and even *The Joy of Sex*. (It's worth noting that the Japanese education ministry is worried about the declining eyesight of Japanese children, a trend it suspects is

due to the fad for video games). Philips estimates sales of one million CD players by the end of this year. Several other proprietary CD players are in the pipeline (See "The compact medium", page 58).

But these products are just the beginning of a new spiral in consumerism that is destined to alter our perceptions of 'staying in'.

"People are bored at home, they want more things to do in the home," says Rob Rohrlach, a director of the Perth-based Smart Company Pty Ltd. Rohrlach's company is a pioneer in home automation, marketing a product known as Jeeves, a software and hardware kit that promises to provide the electronic equivalent of a butler.

Jeeves won't serve port after dinner but, via connections with a variety of sensors and control devices, it will take and relay phone messages, alert you in the case of break-ins and fires, monitor water, gas and electricity use, and control your stereo, TV set, home heating, lights, and even the lawn sprinklers.

Enhanced home security is one of Jeeves's big attractions. The program will turn lights and TV's on and off randomly while you're away, and if connected to the telephone, it can be programmed to ring you at work to tell you a burglar alarm or smoke detector has gone off.

Rohrlach says the level of the consumer interest in Jeeves surprised him. "We targeted it at the DIY types and hobbyists, but the professional security companies and all kinds of people are really taking a look at it." The company has sold several units to security-conscious residents in South Africa, and hopes soon to export to the US.

Home automation of this type is the seed of the 'smart home', a computer-organised 'facility' aimed at the efficient

Continued on page 68



The ultimate office...

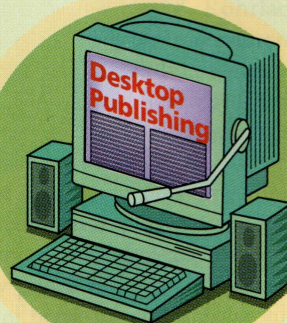
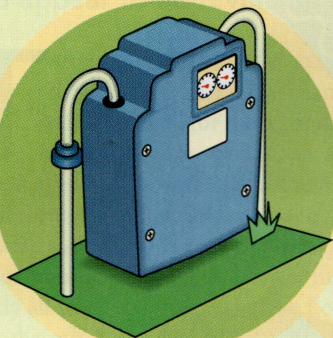
Picture this: It is nearing the end of the century, and the millennium. You are on a remote beach with your partner when the phone rings. You know from the display on your hand-held mobile computer phone that it is a call diverted from your 'office', which these days is just a file server connected to a mainframe, a sophisticated telephone service, and some 'human interface' executive lounges.

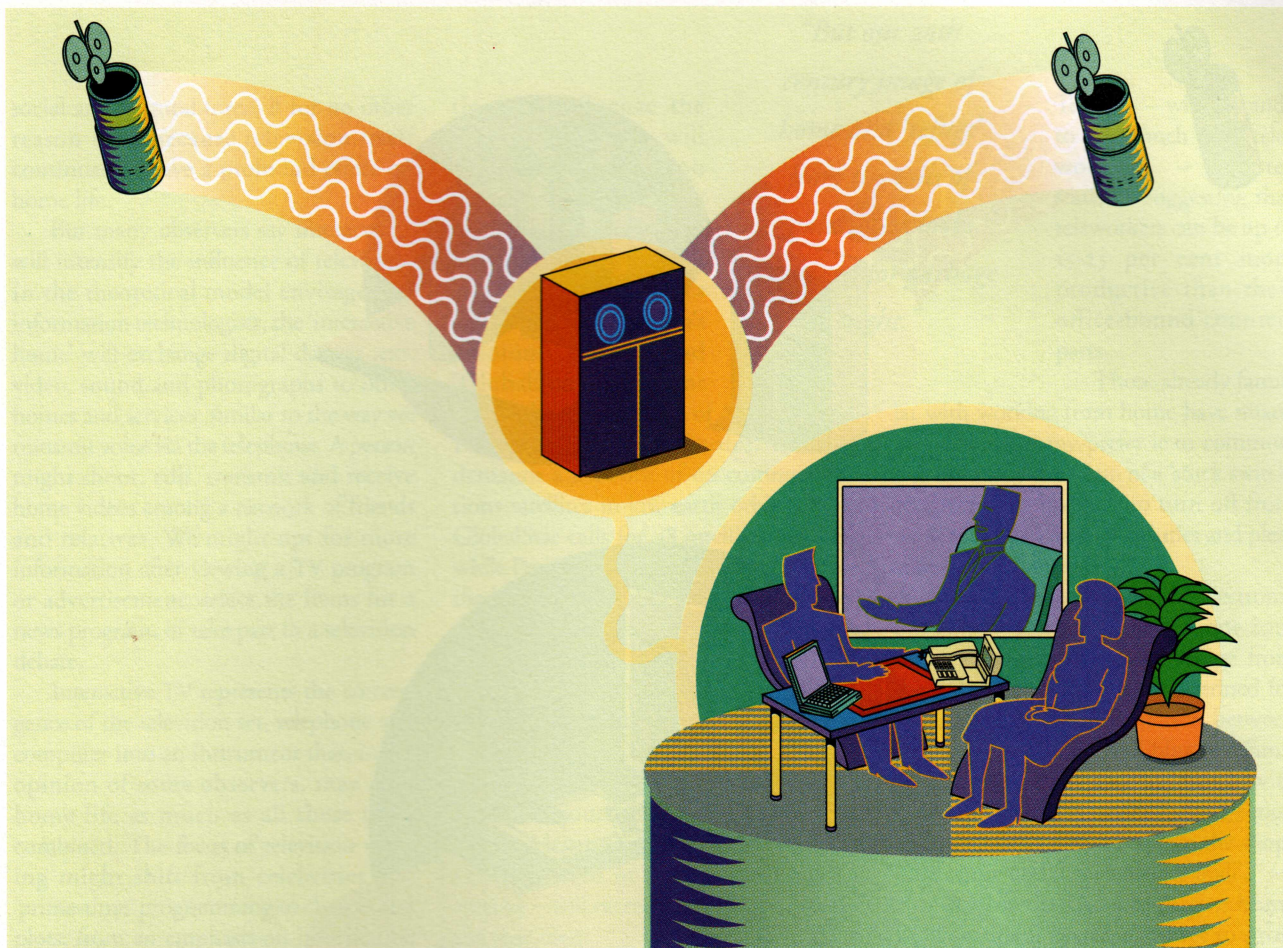
Your corporate colleagues (see page 67) have a wall videophone hook-up with a client in New York (see page 68), and they need some input from you. They key in your Universal Personal Business Telephone (UPBT) number, and a split second later your palm-

top computer is activated. They need your presentation, a full motion video and text data file you updated the day before.

Against a backdrop of crashing waves, you key in the 'office' telephone number, your UPBT, and the file 'tag'. Another split second later, via the antenna on your car, you are wirelessly accessing the file server and the mainframe, via the nearest ground station in the mobile net, the mainframe has retrieved the file from memory and sent it via satellite to New York where it is 'windowed' into the large smart screen display and the 'office' wall screen simultaneously. Your only worry is whether you brought enough UV blockout...

Continued on page 67





the smart home...

Continued from page 65

Arriving home with an ideologically unsound suntan, you and your partner resume running your business, electronic desktop publishing. One calls a client on the video-phone, the other assembles a draft for an interactive marketing video, drawing on sound and graphics stored on CD Rom in your own library and in databases around the world. While a large graphic image file is being downloaded from a remote database at 155 megabits per second, using broadband and high-level compression technology, you ponder whether to invest in an upgrade to connect your home office via optical fibre to the fibre centre, now just 600 metres from your door – allowing you to send and receive data at 2000 megabits per second.

All this time your home management system is automatically monitoring and minimising use of gas, electricity and water,

and automatically paying the bills from your tele-linked bank account. Your home manager includes a complete security maintenance system, which has just noticed that a door on one of the cars in the driveway has been opened. Ironically, while you can compile – and present – your marketing video to your colleagues and clients worldwide, without leaving your desk, you will physically have to go and check the car. Returning to your desk, you upload your completed document, together with a tagged invoice file which automatically transfers your agreed fee for the video into your company account. This is just as well as your daughter in the living room has stopped accessing the MBA full-motion video distance education course, provided by Harvard University, and is tele-shopping for the new season's fashions on the interactive wall screen.



...and the clever company.

Continued from page 67

Meanwhile, at headquarters, your ultimate boss – who now rarely meets the staff face-to-face – is impressed with the rise in productivity since the employees were encouraged to work from whatever location

they felt most comfortable with, despite company e-mail records showing your last appearance in the branch office was just over two years ago.

Continued from page 64

customisation of a house and its appliances to an individual's (or family's) needs and tastes.

Beyond home automation is a myriad of emerging home applications of advanced telecommunications technologies. The list includes videophones, electronic mail, digital mobile voice and data links, pay TV, interactive television, video-on-demand,

home banking, home shopping, and online libraries.

Let's look at just two of these – interactive television and mobile communications. The Melbourne-based Interactive Television Australia (ITVA) Ltd hopes to launch interactive TV game shows on the Seven Network and SBS (and several regional TV networks) by the middle of next year. The shows will allow viewers to guess sports results,

vote in surveys, or directly order products seen in TV commercials.

Viewers will transmit via a modem and the telephone. ITVA plans to give away 210,000 of the units needed to receive the interactive signal, and sell them after that, hoping to pick up a quarter of the TV audience within three years.

Whether these plans come to fruition or not, the development of interactive television is likely to be a powerful

social and cultural force, if for no other reason than because television itself continues to have a profound effect on home life.

But many observers say interactivity will intensify the influence of television. In the theoretical model envisaged by information technologists, the 'interactive home' will exchange digital data as text, video, sound and photographs to other homes and services, similar to the way we transmit voice via the telephone. A person might shoot, edit, transmit and receive home videos among a network of friends and relatives. We might opt for more information after viewing a TV program or advertisement, select the items for a news program, or take part in a television debate.

Interactive TV represents the convergence of the television set, telephone and computer into an instrument that, in the opinion of some observers, may alter home life as much as all these three combined. The focus of television viewing might shift from celebrities and 'prime-time' programming to choices and plots; from an emphasis on information to communication. Judged positively, interactive television potentially departs from the passively received mass imagery of the media towards a shared pleasure in the process of communication itself. The negative view is that the mass media will increasingly expect us to become involved in the public issues of the day, to become actors rather than spectators, and share our private lives Oprah Winfrey-like with the rest of the viewing public. There is little doubt, however, that advertising – already a profound influence on human behavior – will gain an unprecedented opportunity to sell products and promote fashionable lifestyles.

As much as interactive television is expected to enhance and enrich the modern concept of the home, the spread of mobile communications will diminish our traditional image of the office. The smart office will be a transitory state, a distributed workforce performing electronically distributed tasks co-ordinated and partly automated by 'client management' software.

The potential of mobile communica-

tions to influence the nature of work will depend in large part on the construction of truly global satellite networks. At present, three are planned: Inmarsat's 'Project 21', Motorola's 'Iridium' project and 'GlobalStar', a joint venture by a consortium of American and European space companies. Iridium demands a network of 66 communications satellites in low earth orbit (LEO). GlobalStar calls for 48 satellites in LEO, while Project 21 requires an as-yet unspecified number of LEO and geostationary satellites.

ACCORDING TO INMARSAT, THE demand for mobile hand-held satellite telephone services worldwide – from business travellers, journalists or anyone whose work or leisure takes them beyond the reach of fixed or compatible cellular systems – will exceed one million users by the year 2005.

In Australia, two companies – Bell South Mobile Data Australia and Blue Sky Comms – have teamed up to offer a wireless network which enables users in Melbourne and Sydney to send data from a notebook computer, from your car or another remote site. Soon the network will be extended to the other capitals and then overseas.

Networks such as this will enable us to work from connected home offices, sharing information with other offices or a colleague on the road. Incoming phone calls will be re-routed as required to wherever we are at that time. Video-conferencing will become more routine and cheaper, and its equipment will sit on the worker's desk.

Teleworking or telecommuting is growing rapidly in Australia, in line with a trend towards more home-based workers. Reliable Australian figures are not available, but in Europe and the United States there are now an estimated 10 million teleworkers.

Many people resent travelling to work or working with unfriendly colleagues.

"But our 20th century image of home as a 'refuge' from the toils of paid labor looks destined for garbage night."

Telecom – which stands to gain much from teleworking – quotes statistics suggesting that teleworkers can be up to 15-25 per cent more productive than their office-bound counterparts.

Those already familiar with working from home have mixed impressions: many prefer it to commuting, but some complain of a 'stuck switch' syndrome, an inability to turn off from work to tend to domestic duties and pleasures, or vice versa.

Will the home survive the electronic onslaught? Yes, certainly, but our 20th century image of home as a 'refuge' from the toils of paid labor looks destined for garbage night. The distinction between workplace and home will blur and families once again will have to learn how to accommodate both under the same roof. Shopping will be split between the shopping centre and the 'electronic mall'.

Multimedia and interactive home entertainment systems are set to grow rapidly, probably at the expense of cinemas, video shops and sports venues. Home education may assume greater importance. The Open Learning Agency of Australia has investigated the feasibility of offering tertiary courses online, accessible by home-based students using PCs and modems.

Will the office survive? Probably not as we now use it. Changes in the flow of information is already altering the structure of organisation, making them 'flatter' and more decentralised. Industry generally adapts quickly to organisational change, but government bodies are less able to adapt. The vast increase in information and information-based services available electronically means the smarter offices are those that can manage the flow best.

The city office of the near future may be little more than a file server, switching data and voice calls through to a dispersed and mobile staff. Office space may become more 'generic': rented rooms for special meetings and conferences and temporary work spaces. ★

Voice computers talk money

Machines that talk or listen are now appearing in a variety of specialised applications, but the potential for computerised 'voice-tech', as it's called, has hardly been tapped. Ultimately, speech technologies promise to completely replace the keyboard and the millions of jobs that depend on it, and usher millions more who have never used a computer into the Information Age.

ON FRIDAY JAN 28 1993, history was made when Toshiyuki Takezawa of the Advanced Telecommunications Research Institute International (ATR) in Kyoto, Japan, spoke for 20 seconds via a computer to an American scientist at the Carnegie Mellon University in Pittsburgh. Takezawa's words, spoken in Japanese, were understood by the computer, translated into English and reproduced in a synthetic voice for the American recipient.

The continuous speech recognition-translation computer had only a 700 word vocabulary, 10 times less than the Bible's, but ATR's vice-president Kohei Habara said this "tiny, tiny step is a very important one historically".

Speech translation forms, with speech recognition and synthesis, a triad of new computational technologies about to create a mini-

revolution in telecommunications. The potential applications are limitless because speech is the easiest communication medium for people to use. It replaces the need for buttons, keyboards, and in some cases, even computer screens and touch screens. And the implications in terms of job survival for translators, secretaries and telephone operators alone are profound.

Money used to talk – now talk is big money. American AT&T engineer Joseph Olive says the market for speech systems in the United States is worth \$1 billion and is growing at a rate of 20% a year. AT&T now has a 2000-word, continuous speech system that can recognise any American dialect, as well as an automatic lip-reader. Industry observers in the US claim telephone companies can each save \$US25 million a year alone by installing technology which listens to a customer request a collect call and then says in a synthesised voice to the other party, "Collect call from Mr Y, Texas, do you accept?" The system then responds to a "yes" or "no".

Robin King, head of the University of Sydney's speech technology research centre, believes this is where the future lies in Australia – in "systems that operate over the telephone in 'information dialogues' and 'small [voice] transactions'".

Ara Samouelian, head of Telstra's speech technology development section (Telstra formerly OTC), says "voice technologies add a new layer to the core business of the telecommunications world".

Samouelian has had the banks, the TAB, the ABC and many others through his doors recently to appreciate what he calls "the beauty of voice systems", where you don't need a computer in front of you or a terminal in the home, just the common telephone handset. This, he sees, is a new public role for telecommunications companies: a user-friendly interface for customers to use 'speech-tech' to plan holidays and business trips, reserve hotel rooms, order food,

and access libraries, all from the touchtone and pay phone.

Computer companies also see a powerful and lucrative future in speech-driven functions that allow them to sell a new wave of computer products. Gone, effectively, is the keyboard, mouse and touch screen – just adjust the mouth microphone, fold your arms and say "wake-up console, word processing, letter format, Dear Ms X..."

Bill Gates, the CEO of Microsoft, says "speech and listening are key technologies [of the future], that people should invest millions and millions of dollars in". Microsoft recently attempted to takeover Dragon Systems, a small Boston company which produces a state-of-the-art, 70 word-per-minute, 25,000 word vocabulary, 'voice-typewriter' (Dragon Dictate30). Microsoft was eventually forced to buy licence rights to Dragon's speech recognition hardware and software for its next-generation Windows computer operating system. This was to match IBM and Apple licensing Dragon for their 'SpeechServer', and 'Voice Navigator' software respectively. Late last year, IBM stunned the market with the release of its own system, the first 30,000-word vocabulary dictation system under \$US1000.

But the real potential is in speech systems that allow executives, the disabled, older workers undergoing retraining, and people who have never used computers, to join the information age with their voice.

Dragon has already sold thousands of its 'voice-typewriter' units in the United States, Canada and Europe. About 100 units have been bought in Australasia by government agencies, lawyers, doctors, and disabled people through a Perth firm, Southern Group Ltd, at about \$A4000 a unit. With secretarial salaries around \$A20,000, some obvious savings are to be made in the stenographic, transcription and document and file-creation areas.

According to London lawyer Michael Pettman, who introduced the

technology throughout his firm, staff ratios are now reversed. "They used to be 2:1 secretarial to professional, now it's the opposite, with the professionals dictating throughout themselves." One doctor dictates his patient's records onto computer immediately after the patient leaves the treatment room, bypassing the need for a records secretary. The speech recognition system is ideal for professional languages because the technology at present finds it easier to distinguish longer words.

THE SPECTRUM OF POTENTIAL products arising from speech technology is very wide. Robert Mannell, associate director of Macquarie University's Speech, Hearing and Language Research Centre (SHLRC) and a leader in speech synthesis and text-to-speech technologies, says that "five years from now all operating systems will have built-in speech synthesis and speech recognition".

Applications in use or in train include 'voice macros' which allow untrained people to access even the most complex business software by simple keywords that replace up to a 1000 keystrokes in one utterance; hands-free voice-filing for quality checking of cars at the factory; mail-sorting by voice to speed processing by four times; more reliable pathology and cytology-cell analysis by voice in laboratories in hospitals; voice-activated appliances; and a 100-word vocabulary flight-control system for a helicopter.

The US chain of Ross stores has a low-vocabulary automatic shop assistant that allows customers to order products for delivery over the phone. According to *Restaurant Business* magazine, systems are being tested with menu vocabularies so diners can order from their tables, improving service and cutting workload (and perhaps even the need for waiters and waitresses). In Australia, the

Melbourne-based Applied Financial Services (AFS) has licensed and adapted an American voice technology to produce a 100-word system, known as Voice Reporter, which allows dealers on the noisy futures-exchange floor to log price information.

If someone can solve speech details such as the machine recognition of "I would like to check in please" as opposed to "I would like two chicken please", the world is close to being their oyster.

It is truly amazing how scientists and engineers can now mathematically and statistically separate these two

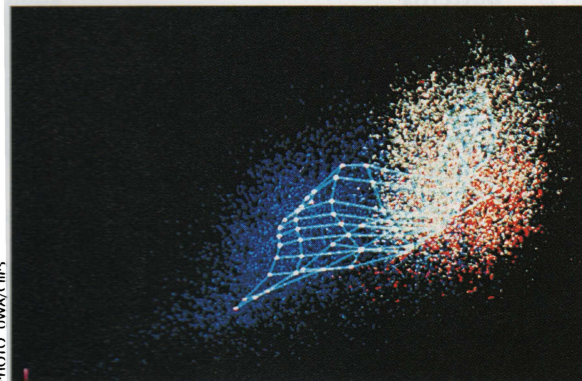
"Speech systems will impact heavily on Australia's 190,000 secretaries and 1.2 million Australian document-creating and handling clerks."

level officers who will be asked to perform these functions by voice from their networked desks – "find Jackson's file" or "get ABS data, report x...".

Ironically, however, the very technology that takes jobs away might aid people to find new jobs through faster retraining, and open up employment prospects and positions for disadvantaged people that did not exist without voice-tech. According to Graham Reynolds, Managing Director of AUSCRIPT, the Federal Government's national reporting service, the new Dragon systems provide remarkable retraining opportunities for disabled and unemployed people, those made redundant and those reluctant to use computers, allowing them to access and join the new workplace environments. Reynolds believes such recognition systems will become "the total user interface".

An area where speech technologies will have tremendous impact is in the business translation arena. The new technology severely questions the current bureaucratic premise and logic of thousands of young Australians learning Asian languages to become translators and business communicators. If an inexpensive desktop machine can perform adequate business translation for us, why bother learning business languages at all?

The Japanese are driving the translation research and innovation, due in part to a tyranny of language isolation, but also because of an undeniable economic goldmine. If they can crack the problems associated with processing continuous speech, miniaturisation and price barriers, the technology is destined to be as important as that of the compact radio market of the 1960s. Surveys by Japan's



Researchers are visualising sentences in '4-D' images that capture the meanings of language.

statements for potential restaurant and hotel applications, and to compress the various algorithmic and statistical "templates" that manage a large vocabulary into a small laptop computer. Some researchers believe one neuron in the brain is the biological template for numerous fields of language, and the scientists hope to match that in silicon.

However, no scientific and engineering development, or corporate implementation, is without its social costs. Speech systems will impact heavily on Australia's 190,000 secretaries and 1.2 million Australian document-creating and handling clerks. Their tasks will be largely subsumed into the workload of higher

Ministry of International Trade and Industry in March last year, point to the translation market being worth 60 billion yen a year. Allowing for the work of other hidden translation in companies and organisations (and by free-lancers) the true figure might be "well over 1 trillion yen".

According to NEC vice-president Hajime Sasaki, speech translation technologies will allow Japanese managers and engineers to speed up production in their far-flung electronic manufacturing empires. These technologies will allow the Japanese to begin to control globally, through centralised hubs in Japan, the spoken word and text of the business paradigms of the late 1990s.

MEANWHILE, AUSTRALIA IS formulating policy in many States to make the learning of Asian business languages compulsory for primary and secondary students. Japanese requires 2000 hours before fluency compared to 800 for European languages. In the light of the Japanese innovation, who needs future translators or bi-linguists? Might Australian students be better directed to more creative paradigms or cleverer aspects of markets and culture?

Startling as all this sounds, consider that future moment when it will be impossible to know who is real or artificial at the other end of the phone line. A counter-arguing artificial salesperson is being developed in the German MEDLAR project to carry out a natural conversation with a customer and convince prospective purchasers to buy such things as BMW cars (BMW is a project sponsor).

Imagine also the smart telephone equivalent which is programmed to call up customers at all hours of the day and night to argue a hard sell – in other words, voice junk mail. Speech technologies are seen by many as an economic panacea and by others as a whole Pandora's box of issues. They are full of the excellent, the good, the bad and the ugly.

In Australia, there are some 50 researchers in seven universities engaged in speech recognition and synthesis research & development, and another 40 in government and commercial laboratories, and speech system product sales.

Among the research teams is the University of Western Australia's Centre for Intelligent Information Processing Systems (CIIPS) in Perth, a speech and imaging centre under the

"Applications in use or in train include 'voice macros' which allow untrained people to access even the most complex business software by simple keywords that replace up to a 1000 keystrokes in one utterance."

guidance of neural-network expert Yanni Attikiouzel. His visionary ideas about speech are literally visionary. Using graphics computers to visualise speech and language in four dimensions of space/ time, Attikiouzel and his group are generating pictures of sentences and language which look like galaxies

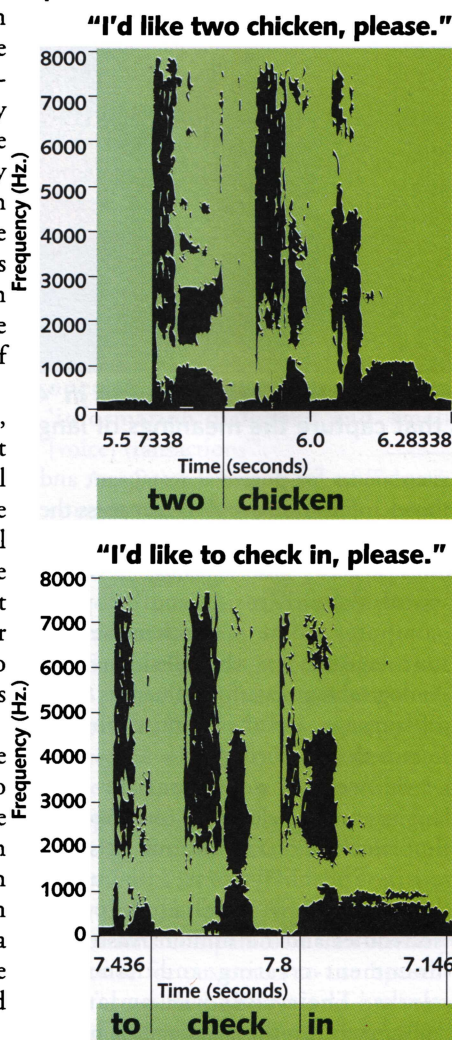
of stars, and which researchers can view from different angles, warp and twist to capture the hidden mysteries of meaning. The CIIPs scientists believe this '4-D' visualisation technique, and subsequent mathematical representation of the language pictures, holds vital keys to unlocking the miracle of speech and language.

The Perth group now talk about language in trajectories, and they play language games of 'guess-the-sentence' from the galactic pictures. However, the games have serious implications for efforts to aid people with hearing disabilities to recognise speech. Researchers around the world are trying to capture the essence or skeleton of speech in mathematical and algorithmic terms. These descriptions, which are called "templates", "patterns" or "features", are required in a compact form if practical systems are to run on desktop computers rather than massive supercomputers. Attikiouzel believes this research into the truer "topological structure of speech space" has provided Australians with a unique lead in this research field.

In continuous-speech recognition, Mary O'Kane's team at the University of Canberra has won accolades overseas for their achievements in "word-spotting".

Word-spotting is an ancient military game of intelligence processing and analysis. The big spy computers at Pine Gap and CIA Headquarters at Langley, Virginia, sift through electronic communications gathered by satellite and other radio

A fowl hotel: a spectrogram showing differences in speech patterns



means for keywords revealing topics of military interest.

For example, an intelligence agency might listen into embassy communications for a euphemism like "hot chilli" – a code-word that a military attache is using. The machine is then told to locate every use of "hot chilli" in stacks of digitised tape messages.

The fashionable mainstream approach to machine recognition is via so-called Hidden Markov Models, which are training algorithms requiring hundreds of speaker examples for every trained word. This approach is expensive and requires huge amounts of processing power and large data bases.

O'Kane prefers what she calls a "statistical rule-based approach" which attempts to find the basic keys for the building blocks of words. Essentially the goal is to find the skeletal rules in phonetics, phonology, syntax, and semantics which combine to build syllables, words and phrases. "Larger linguistic units are derived from sequences of these basic patterns," she says.

An added bonus of developing systems based on probability is that they can often predict the next likely phoneme or word. Some humans do this automatically in conversation. The rules also allow the system to infer the correct sound if a door slams producing unwanted noise which overrides the speaker.

"The system is particularly good for proper names and a relatively recent innovation is that only small amounts of training data are needed for the systems to learn proper names", O'Kane says. Agencies like the police have become "terribly interested in it", she adds.

At the other end of the spectrum, there are formidable complexities in the synthesis of speech. Jonathan Harrington, director of Macquarie University's Speech, Hearing and

Language Research Centre (SHLRC), says synthetic speech needs to be flexible enough to respond to people in their preferred accent. Imagine the ingenuity of the rail-ticketing machine that needs to quickly analyse "seedny", "sidnee" and "zoodnee", depending whether you are from Barcelona, Glasgow or the Urals

"The diversity of language is staggering," says Harrington, especially in terms of accent variation, variation due to different acoustic signals, and even a cold with that "runny doze". Any practical general-user telephone system

"Speech translation technologies will allow... the Japanese to begin to control globally, through centralised hubs in Japan, the spoken word and text of the business paradigms of the late 1990s."

example, which is a 30 year investment.

"The fascinating thing about ATR," she says, "is that it has been set up with 70% government money, and only 30% industry. But while Government foots the major capital bill, industry foots the staffing bill with

researchers coming in for three to four year terms. That way any expertise developed in speech recognition and natural language understanding is continually cycled out into the participating Japanese firms."

Finally, four centres – the University of Sydney, the Australian Hearing Services, Macquarie University and the Australian National University – recently combined to create the Australian National Database of Spoken Language (ANDOSL), to classify the speech characteristics of 300 "dinky-di Aussie" dialects and a number of migrant speakers for future recognition and synthesis usage. The resulting speech data will be integrated into a file structure stored on CD-Rom discs.

The new project is the language equivalent of the human genome project which seeks to classify the genetic structure of human life. ANDOSL is a phonemic parallel, albeit still fragmented from the wider global meaning of other language projects and cultural meanings.

According to ANDOSL researcher, Chris Cleirigh, the analysis will be stored for future use by recognition and synthesis explorers and commercialists to adapt for their street-level applications. He is also looking into new approaches that might one day interpret language in ways that reflect the meanings inherent in chaos theory and quantum mechanics. To Cleirigh, "language is a living organism" and should be treated as such. ★



Court talk: Court reporters in NSW are now using voice-typewriters to speed up their transcription work.

needs to cope with accent diversity if it is to be commercially robust.

Mannell has just successfully completed a three-year project to develop a smart synthesiser with an Australian accent for Telecom to be used in telephone systems. Mannell also plans to model human vocal emotion for more realistic synthesis.

O'Kane laments the Federal Government's apathetic attitude to funding longer-term development technology projects. "You have to pick a couple of winners sometimes and run with them." She would like the government to follow the example set by Japan's ATR special initiative

The Net – promise or threat?

Computer communications are changing the way we live but governments and corporations want to direct the changes. Computer networks such as Internet represent the active resistance, a new public space where the users control their own information needs.

COMPUTER NETWORKS WERE spawned in the 1970s with the launching of the telecommunications satellites. Since then we've seen networks grow country by country, closing geographical boundaries at such a rate that the technical developments in this field alone have far exceeded expectations. In less than 20 years, transmission speeds have improved to such an extent that it can take less than two-thirds of a second to send an electronic mail (e-mail) message from the United States to Antarctica.

Increasingly our world is moving onto these networks, which are collectively referred to as 'the Net'. As we see more of our lives shift towards the Net, governments and corporations are exerting their control over the use and access to these public spaces. Yet it was the spirit of public access to information and communication technologies that largely inspired the creation and cross-pollination of the Net – that it would be open to anyone wishing to speak, publish and communicate with people whom you share values, interests and attitudes. The phenomenon of this

medium is perhaps as profound as the invention of the printing press was to the church: the liberalising of information, taking it out of the hands of an isolated intelligentsia and making it available to the broad community starved of information and knowledge.

The Net poses a threat to governments and corporations wishing to control information flow to their communities. For some time it was thought the hardest hit would be paper-based industries such as newspapers and magazines. In a recent forum in Sydney, a representative from Rupert Murdoch's News Corporation said that if anyone should be aware of the impacts of technologies such as paperless networking medias, it would be Kerry Packer and Murdoch. In recent months, both corporations have invested heavily in the purchase of printing facilities. So what of computer networks? Perhaps in the short term we can count our blessings they will not be overrun by mainstream media and industries as the media giants clamor to find new ways to enter our homes. The Net may now be relatively free of this invasion, but for how long? The world's largest and potentially most marginalised of interconnected networks, the Internet, has not gone unnoticed by these industries. This network of networks is the fastest growing, furthest reaching of networks and was designed to maintain consistent data flow in case of unforeseen breaks in communication. It was afterall originally designed for military use.

The Internet is made up of more than 16 thousand connected networks, encompassing up to 8 million users. It includes all kinds of diverse public and private networks, gateways, and backbones, in almost every country and region of the world, from Antarctica to Siberia, from Mongolia to Manitoba.

For the month of June 1993, 6,932,825,104,700 bytes of data was recorded moving through the

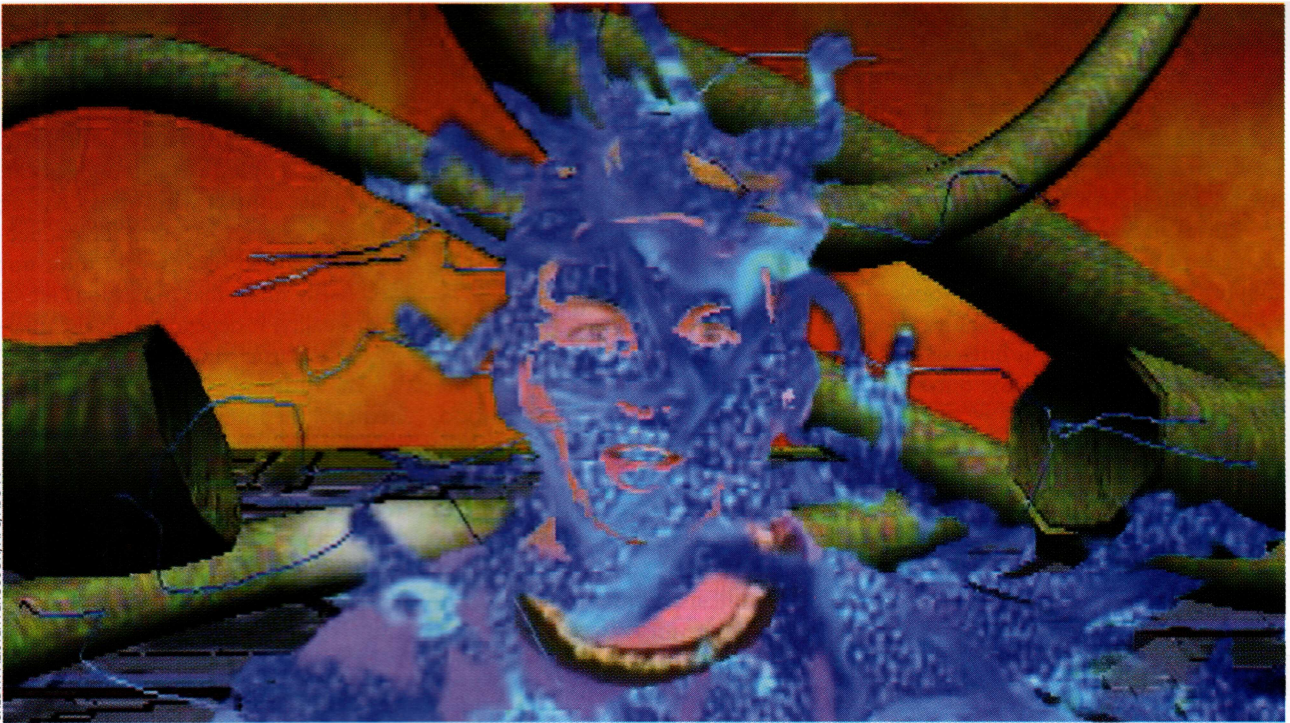
Internet. Up to 137 countries may have been in receipt of this data, or may well have participated in its creation. Only about 100 countries are not reachable via e-mail.

With such growth patterns, and such far-reaching connectivity, it is no wonder the business world is beginning to look favorably on networks to provide conduits to new markets and more efficient communication with globally distributed clients. Along with this has been the move among some official bodies to curtail certain aspects of network activity. In the US, this has reached the stage where the surveillance of certain individuals and confiscation of computer equipment, along with the closure of many electronic bulletin boards (micro-networks often used for specialist information sharing), resembles the 'Red scares' of the 1950s. The most infamous campaign was Operation Sun Devil in May 1990, which involved 28 raids in 14 days, and the confiscation of 42 computers and 23 000 diskettes. Dawn raids by government agents were carried out on teenage bedrooms across the US. Now there are moves by the Clinton Administration to regulate the use of encryption software (programmes that ensure the security of data exchange).

What we are seeing is a reaction against a medium with which the public sector can choose to be informed in a way it sees fit, and to do so privately. It's what the late Frank Zappa, composer and outspoken critic of government ideology, called "a conspiracy against conscious thought".

"The surveillance of individuals and confiscation of computer equipment, along with the closure of many electronic bulletin boards, resembles the 'Red scares' of the 1950s."

The Net, however, is as open to abuse by groups and individuals as is any public space. There are few organisations and institutions able to tackle the hard questions of censorship, ownership of information, pricing and regulations. We are also unable to predict just what kind of impact the current use of the Net will have on society, and how



that will translate into solutions to the questions being raised now by policy-makers and organisations such as the US-based Electronic Frontier Foundation, a non-profit outfit dedicated to advancing freedom and openness in computer-based communications. Internet researcher Daniel Ingvarson <ingvar@csuvax1.murdoch.edu.au> suggests the benefits of the centre on human interaction. "The Net is a technology which creates another space, a space for communication, just as ordinary mail did, the printing press did, and the telephone did. All of these are as significant as catalyst for change as the atomic bomb, however their impacts are seen in the results of what they create, not what the technology itself provides," he said.

Computers are fast empowering people to use them for their own needs rather than their expected role. This is evidenced in the growth and extent of such networks as the global Association for Progressive Communications (APC) that have been providing low-cost net access to communities to both the developed and developing world for over 6 years to nearly 100 countries. The APC has 16 member networks AlterNex

(Brazil), Chasque (Uruguay), ComLink (Germany), EcuaneX (Ecuador), GlasNet (Russia), GreenNet (UK), IGC (United States), LaNeta (Mexico), Nicarao (Nicaragua), NordNet (Sweden), Pegasus (Australia), SangoNet (South Africa), Histria (Slovenia), GLUK (Ukraine), Wamani (Argentina), and Web (Canada).

Each of these networks provides valuable information resources to their communities, even in countries where few people have access to computers.

During the Soviet coup of August 19-23, 1991, the Russian staff of the Moscow-based GlasNet opposed the coup and kept GlasNet operating. GlasNet's activities became the fastest and most direct reporting of what had occurred.

Again in Russia, personal accounts were electronically 'posted' to various APC conferences detailing the October 1993 arrest, beating and attempted frame-up of members of the democratic opposition for the murder of two policemen. These postings, from Vasily Balog <vbalog@glas.apc.org>, deputy head of the coordinating body of the major union federations, and a frequent user of e-mail via GlasNet, appealed for phone

calls demanding the release of the detainees. One of the arrested, Boris Kagarlitsky, was watching from the cell when calls started coming in. "One of the first was from Japan. The police didn't seem able to believe it. After that, the calls seemed to be coming from everywhere."

Within a few hours most of the detainees were released, and the frame-up charges were dropped. With progressive movements increasingly using the Net, it is clear repression will never be so easy again. The world is watching.

Consequently, the Net is the place where the public themselves become information providers and participants in an active ever-expanding medium that brings people together, as opposed to the isolation and disempowerment we often experience when exposed to the mainstream media.

Computer networks are the new public access media, far easier to get onto, play with and interact with people, regardless of time, geography, race, sex or religion. The artist David Nerlich <babel@peg.apc.org> put it succinctly: "In cyberspace, discrimination based on physical characteristics like age, and physical beauty disappear."

Author Dale Spender <dspender@peg.apc.org> once said the networks empower the reader to become the author. In that sense, each participant to the Net is potentially a source of new information, fresh ideas. No one need remain passive.

But as networks undergo massive changes in technical infrastructure to support the demands on them, legislation to curb illicit activities, and the encroachment of corporate interests, it is clear we know less what the outcome will be than ever.

For the time being, one thing is certain, that if Lewis Carroll's Alice were to peer into today's 'looking glass', she would see a world enmeshed in a complex web of interlinked electronic communities where not everybody may agree with her point of view, nor even like her, but they would more than likely communicate to share common concerns. ★

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Internet: the network of networks

THE INTERNET IS A WORLDWIDE community of communicating computers – over two million of them, with around 98,000 computers in the network in Australia alone.

Electronic mail (e-mail) is perhaps the best known of the services available on the Internet. People in the same and different organisations are able to send text messages and exchange data in a convenient manner. Unlike the telephone, e-mail allows a person to deal with an incoming message when it is convenient; messages might be dealt with as they arrive, or be read as the first task of the day. Some messages may require immediate response, while others, for example a broadcast message of an upcoming conference, may be of little interest, and require no action at all.

E-mail allows communication between workers in different time zones, without them having to be in the office at the same time. It also removes hierarchy within organisations.

Technical workers in international groups use e-mail. For example the International Standards Organisation Motion Pictures Experts Group (MPEG) meet three times each year. Discussion and work take place between meetings in formally established *ad hoc* groups, with e-mail being the principle means of communications within these *ad hoc* groups. Typically an e-mail 'exploder' is established, containing a list of the e-mail addresses of participants. Messages sent to the exploder address are broadcast to all *ad hoc* group members.

Netnews is another popular Internet messaging service which provides over 3000 interest groups in a 'bulletin board' format. Interest groups range from academic, such as *sci.math.num-analysis*

to entertainment, such as *alt.music.peter-gabriel*. Such electronic bulletin boards allows users to post enquiries about specific issues in the hope that a reader may be able to respond. People in isolated areas can thus make contact with others having shared interests. Of course the connectivity provided by Internet does not necessarily mean that discussions are of high quality; it depends upon the quality of the participants.

In addition to the e-mail and netnews, the Internet offers database or archive type services. The file transfer protocol known as 'ftp' allows users to transfer electronic files from computer to computer. A user usually requires an account on the remote computer, however 'anonymous ftp' allows users to transfer files from remote computers which have been configured to allow public access. Making a document available via anonymous ftp leads to the concept of publishing on the Internet, allowing documents to be quickly released to the public.

With a wealth of public information now available on the Internet, resource discovery tools are required to assist with organising and finding that information. 'Gopher' is a tool that presents to the user a hierarchical directory structure of documents, possibly located at different physical sites. Wide Area Information Service (WAIS) and World-Wide Web (W3) provide similar functionality.

How did the Internet come about? The US Defence Department established an experimental network some 20 years ago, called ARPAnet. The set of rules dealing with placing user data into a packet for transmission, and the addressing of that packet, was called Transmission Control Protocol/Internet Protocol (TCP/IP), or simply the Internet Protocol (IP). IP became widespread as computer manufacturers sought a common means of communication with computers from other manufacturers. IP was installed in most UNIX workstations, connected together by local area networks (LANs). Connections with other Internet LANs allowed a powerful new form of commu-

nication. A further boost to the IP protocol was provided in the late 1980s by the National Science Foundation in the US. It chose the Internet Protocol as the basis for NSFNET, its network for connection of universities, and later secondary, and primary schools, to five supercomputing centres.

Other network and protocols were being developed at the same time as the Internet was being developed. However there was much to be gained in connecting these networks to the Internet. Previously 'the Internet' referred to networks using the Internet Protocol. However gateways to networks using different protocols has meant that these networks may also be thought of as part of the Internet.

In Australia data communications between academic and research institutions are provided by the Australian Academic and Research (Computer Network (AARNet). In 1990 the Australian Vice-Chancellors Committee established AARNet to provide "computer based communication service to Australian academics and researchers to enable the dissemination of information and knowledge, encourage dialogue, debate, and the interchange of ideas, and to foster intellectual and cultural sharing, cooperation, and understanding".

AARNet is itself an IP network. Universities and research institutions physically connect their own local networks via Telecom-leased data lines, or privately owned lines, to the national hub at Melbourne University. A link between Melbourne and California connects AARNet to the Internet in the United States and the rest of the world. AARNet costs are borne by participating institutions; individual users are not charged.

A subject of recent debate has been how to make available in Australia an affordable Internet

connection for commercial purposes. Given that the value of Internet services has been well proven in the academic world, why shouldn't the commercial world have access to these services?

The Australian Vice-Chancellors Committee is reluctant to allow its network to be used for purposes other than research. However a number of connection options for commercial purposes are currently available. Commercial users can gain AARNet access as affiliate members. There are two grades of membership, being as a mail affiliate or as a network affiliate. The former provides a limited range of services and costs less. Several organisations also sell access to AARNet for commercial purposes. Some Australian companies gain Internet access using privately leased lines to the United States. However this is expensive. It is also expensive to set up a network that parallels AARNet.

Experiments in transmitting audio and video over the Internet have been conducted. The Internet Engineering Task Force regularly broadcasts live audio and video from its meetings. At

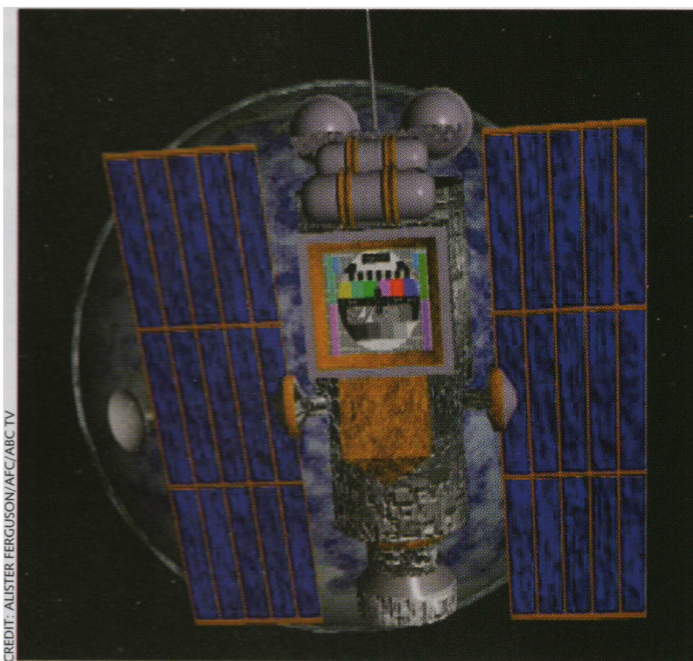
"Given that the value of Internet services has been well proven in the academic world, why shouldn't the commercial world have access to these services?"

the November 1993 meeting 629 remote host computers observed the meeting. Recorded and live audio and video from a recent Columbia space mission was broadcast on the Internet by NASA in November 1993.

While Internet protocols were being installed, the International Standards Organisation (ISO) was defining protocols for computer communication, with the expectation that the ISO 'open systems' approach would be later adopted. Much of this work is completed. The Internet community itself has no authority as a standards body. The issue now is how should the move to ISO protocols occur given there is a large established base of computers using Internet protocols which are proven to work. In fact a change in the Internet protocol is required, since the Internet address space will soon be used up. Expansion of the address space from 32 bits to 64 bits has been proposed. It may be that systems delivered in the future will have both ISO and Internet protocols installed. ★

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The curse of e-mail

Electronic mail or e-mail is becoming a popular form of interpersonal communication for business, academia and government bureaucracies. According to a 1991 estimate, the global market for electronic mail services is growing at a rate of 35% a year. But some organisational users are questioning whether e-mail wastes time and breeds bad management practices.

AN ESTIMATED 500,000 PEOPLE use the Australian Academic Research Network (AARNet), a network which allows academics to exchange electronic mail and data and get access to informational databases and library catalogues. Enthusiasm for electronic mail as a medium for office communications is also spreading among government and business organisations.

Accompanying this eager adoption of new technology has been a rhetoric extolling the virtues of e-mail. A common claim is that electronic mail will replace written and verbal communication in the office, as well as provide valuable time savings. However, experience with information technology in the office to date has shown that achieving the expected productivity benefits is far from certain.

I would like to make some anecdotal observations on why electronic mail may not provide as many benefits as

expected. Electronic mail is more than just a 'two-edged sword' depending on good or bad use; it has the inherent potential to alter existing communication and power structures within an office or organisation.

Electronic mail has the potential to replace much of the written communication in offices. In theory, reductions should occur in transmission time for messages, and in the costs of ordinary mail and paper as well. With electronic mail, the distribution of multiple copies of messages becomes easier and so too does document storage and filing. However, electronic mail will not always be able to substitute for all written communication.

In large organisations, where not every employee is on the network, paper copies of important documents still have to be circulated in internal mail or the regular postal service. Transmission times of a tenth of a second or so may be convenient for management, but if the recipient is not in the office or just not in the habit of opening up the electronic mailbox regularly, then the message is not read and may lose its currency. I have heard of workers who never look at their mail boxes or only open electronic mail if the sender is personally known to them. Given the vast amount of junk mail that can accumulate in an electronic mailbox (e.g. classified advertisements), these strategies become one way of screening out unwanted messages and interruptions.

Electronic mail may well substitute for postal and even telephone use but then not all business communications can be reduced to text-only format.

The issue of the reduction of paper in the office is also not clear. I am constantly surprised at the amount of e-mail messages that are printed out and kept in hard copy form or forwarded electronically to others for them to read and decide to keep or not. For example, during one typical week alone at my university, I

received some 134 messages which printed out onto 128 pages of A4 paper. Of all these messages, I was the sole addressee for only 6 of them so I am evidently receiving a lot of fairly general mail. I consider myself partly responsible for this situation as I could have blocked some of the more general messages. By getting more mail, I thought I was being better informed. When I did send an e-mail message to a manager of one of our large networks (who regularly receives over 300 messages a day), I should not have been surprised when I didn't get a reply.

The ease of copying and transmitting mail messages may well be a factor contributing to this apparent information explosion. The office practice of keeping records, either officially or unofficially, in case questions are asked may also be driving this tendency towards proliferation. In short, electronic mail, as it is currently used, is adding to existing channels (e.g. paper memos, telephone conversations) of communication in the office, but is having difficulty substituting for many written communications. Moreover, not all communication in an organisation is written and this is where further complications can arise.

Electronic mail can replace verbal communication in an office by eliminating the tedious procedure of 'telephone tag' (i.e. wasting time by calling someone when they are not in their office) and much of the informal conversation that goes along with discussions in the corridor, during coffee break or on the telephone. E-mail facilitates ease of communication with many people at one time and it allows busy executives to write messages at odd

hours (e.g. late at night) or overcome time-zones. Electronic mail also allows for a written record of all business communications to be kept – in this way it can become a very 'conversational' medium, less formal than a written memo but more bind-

"Experience with information technology in the office to date has shown that achieving the expected productivity benefits is far from certain."



ILLUSTRATION: MARK NEWBOUND

ing than the spoken word.

The problem is that over reliance on electronic mail as a substitute for verbal or face-to-face communication in an office can have negative effects. For example, regular staff meetings can be replaced by detailed and remote management of a department using electronic mail. Text-only communication can alienate bosses from workers as well as create divisions in the workplace between peers. It is quite feasible for two workers in adjoining offices to have nasty misunderstandings from sending elec-

tronic mail messages to each other when a richer form of communication might have been better.

As one Australian academic observed: "It is a strange medium; people say it is the same as paper but it isn't. If I send a letter to someone, I'll look at it before I post it and maybe put it to one side if it seems offensive. But with e-mail you write what you think and hit the return key and it's gone without any reflection at all."

The following extract of a one-way flow of e-mail messages between a boss and a subordinate illustrates the above point:

Date: Tuesday, 19 May 1992,
7.04 pm

...If the checking of papers is not settled on Wednesday then I will reconsider all requests for attending conferences. I am VERY ANNOYED that I have to write this E-mail. And I must add that.... HAS done what has been asked and expected of him.

BOSS

Date: Wednesday, 20 May 1992, 3.42 pm

Please make an appointment with my secretary to see me when you have time (early next week will do). We need to discuss a few matters including your attitude to [work] papers and working as part of a team.

BOSS

Date: Wednesday, 20 May 1992, 4.29 pm

...Your recent attitude to player [sic] lawyer to defend yourself is completely unacceptable to me. I suggest that you drop this approach before speaking to me again....

BOSS

IN THIS EXAMPLE, THE BOSS IS USING the electronic mail medium to deliver a form of punishment and to block the chance of a face to face encounter. The message sequence is important. The employee has to 'sweat it out' for several days until he gets his change to sort out the problem which has been redefined by the boss as an 'attitude problem'. Worse still, the employee is made to look incompetent and disobedient as the e-mail text gives no

An e-mail case study

The Institute for Science and Technology Policy at Murdoch University in Perth says the rapid rise of electronic networks such as Internet is creating broad social and policy issues that society's decision makers may not sufficiently understand or appreciate. Nevertheless a survey of the institute's own e-mail users has produced a highly favorable picture of electronic networking.

The survey found:

- * E-mail had become standard practice among most of the institute's academic and research staff and postgraduate students, and had created many contacts for staff, particularly overseas;
- * 80% of e-mail users at the institute responded to e-mail faster than ordinary mail;
- * 90% found e-mail easier for overseas contacts than fax or phone;

- * 90% said they had contacts who communicated with them by e-mail only;
- * 80% said they would not have contacted some people if they were not on e-mail.

Source: D Ingvarson, D. Marinova and P Newman, *Electronic networking: Social and policy aspects of a rapidly growing technology*, undated document from ISTEP, Murdoch University, WA.

hint of the context surrounding the events that took place. The fact that there is now a written record of his incompetence would probably generate a climate of fear. It is therefore not surprising to find electronic mail being printed out and filed by workers as a form of protection.

The attitude of management to electronic mail can seriously affect the productivity benefits that are possible. Workers may start to see the network as a vehicle for surveillance and managerial control. This is evident when management starts to use electronic mail as a way of manipulating decision making or as a way of distributing internal 'press releases'. Lower-status workers are often reticent to enter into electronic discussions. I have seen a manager request suggestions from selected staff on a sensitive issue and then forward (without permission) these suggestions to the rest of the organisation using electronic mail for instant feedback. The result is that management can avoid criticism by shifting the blame back on to those making the suggestions.

Electronic mail can reduce the time-wasting experience of 'telephone tag' but it also has associated it with an urgency that can be misplaced in the office. Not all office tasks require the same degree of urgency. I know of one professional employee who was sent an e-mail communication from the boss at 2.30 pm requesting a reply by 5 pm the same day. If not, certain decisions which were the employee's responsibility would be taken without their input. The boss knew the employee would not be in the office that afternoon, was not logged onto the network, and had no prior notice a decision was required. In this case, electronic mail enables the formal requirements of consultation to be met but it clearly shifts decision-making power to those who already have possession of crucial information.

Electronic mail is supposed to be time saving. My own experience is that quite a lot of my time could easily be spent reading and composing replies to electronic messages, many of which are of doubtful quality and little interest. Of

the 134 messages I received in one week, 86 per cent of the total were irrelevant to my immediate work tasks at the university or of little or no interest to me. Some 33 per cent were classified advertisements and another 30 per cent were about general university events and seminars (which during that week were not of relevance either). Only one message dealt with research (and this came from overseas) and only eight per cent of the total were directly relevant to my work and at the time moderately important.

I ESTIMATE I WOULD SPEND ABOUT 30 minutes a day dealing with my electronic messages alone. Over a year, this means about a sixteenth of my work time is spent on e-mail. Assuming I earn \$40,000 a year, then the annual salary cost to the organisation for me reading mail is about \$2,500. Admittedly, the university has now shifted messages such as 'classified mail' onto electronic bulletin boards and this has reduced the information overburden somewhat. Thankfully, I suspect there is now also a heightened awareness of the need for better management of electronic mail.

The point is that information has a cost and this is not often measured, nor properly appreciated. Some people can get 'hooked' on sending messages and tracking their way around the vast amounts of networked information available. They can look busy and even gain kudos for showing-off their navigational skills, but with little productive output to show. Managers too can become obsessed with electronic mail as a management tool, sitting in front of the screen all day dealing with a flood of trivia which should have been delegated while important management issues are neglected. One recent survey of personal computer users in the US has reported that the average user wastes 5.1 hours every week tinkering with layouts and fonts on the computer – this

*"Text-only
communication
can alienate
bosses from
workers as well as
create divisions in
the workplace
between peers."*

becomes a costly (2 per cent of GDP) obsession. If screen-time wasting is counted as a cost, then electronic mail could provide avenues for even more time wasting.

If time savings are achieved, then these need to be reinvested in ways that enhance the effectiveness of the

organisation. For example, freeing up university researchers to search for costly electronic information of dubious quality and in quantities they do not have the time to absorb may not be an effective use of organisational resources. It is clear that not much thought has gone into managing this process in many organisations, especially in relation to its application to teaching and research.

In summary, I have argued that certain benefits are expected from electronic mail. Whether these benefits are indeed seen as advantages or disadvantages will depend on an individual's position and role in an organisation as well as organisation's culture and power structure. The potential for mismanagement, time-wasting and information overload is very real. What is clear is that the benefits of electronic mail are far from self-evident, and perceptive management is needed if productivity is to be enhanced. ★

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The IT challenge to retail banking

Banking in Australia is expected to undergo substantial change in the next five to 10 years due to unprecedented exposure to new information technologies. The effective management of these technologies will alter the nature of work for bank staff, and give some banks a competitive edge over others.

AUSTRALIAN RETAIL BANKS (including building societies and credit unions) are noted for their quick uptake of new information technologies (IT). For example, the introduction of automatic teller machines (ATM) networks in the late 1970s, and electronic funds transfer-point of sale (EFTPOS) experiments in the mid-1980s, put Australia ahead of the rest of the world.

The rapid transfer and application of these technologies to the banking sector is understandable. Australia's major population centres are spread diversely over the continent, requiring retail banks to have extensive branch networks. To contain costs, banks substituted labor-saving technologies for labor-using ones – essentially they substituted EFT technology for paper processing. The introduction of EFT technology was aided by a population sufficiently well-educated in the ways of IT to be able to

accept and use the new devices.

Since financial deregulation in the mid-1980s, the retail bank market has become more segmented. Let us take the two extremes of the market, the 'boutique' bank and the 'financial supermarket'. On the one hand, boutique banks with few branches and a high proportion of well-off customers and business people, use sophisticated client account information systems to ensure each client receives tailor-made advice, counselling and exceptional service, including after-hours service. On the other hand, financial supermarkets service the many average mums and dads who are – in the main – low asset, low liability customers. The financial supermarkets are characterised by their extensive branch networks, expensive technological funds transfer, and delivery systems allowing customers to bypass customer relations officers. Their clients have relatively homogeneous asset holdings such as EFT-linked call and term savings products as well as real estate. Their liabilities consist of mortgages and personal loans. The financial supermarkets rely upon a high volume of low value transactions and fine margins to operate efficiently and profitably.

The new IT being introduced will permit both the boutique banks and the financial supermarkets to operate more effectively by providing the former with better management information systems to target and service their high-value clients, and the latter with more powerful and cost effective means of processing a large volume of transactions. Conversely, lack of timely adoption and effective management of the IT could result in substantial loss of business.

Powerful personal computers (PCs) linked with multimedia technology are rapidly changing the banking workplace. For example, Advance Bank have moved to a system of computer imaging where record-keeping, work-flow applications,

and retail lending information, is either scanned or faxed onto an optical storage disk. The system has extensive 'intelligence' built into it so that, for example, not only can loan documents be viewed on the PC screen, but the loan can be processed through a credit scoring model which rates loan applications, or an external system such as a credit reference checking system.

The main advantages of imaging are in reducing the movement of paper and improving accessibility and storage of records. Ian McGilchrist of the Advance Bank says there are also large spin-off benefits in handling the human chain of operations better. A much greater number of people can access or reference documents and expert systems, resulting in fewer errors. Bankers Trust Australia is another financial organisation that has switched to computer imaging, and is experiencing benefits.

Imaging is changing the corporate culture of the bank but is there a downside? Yes – the cost of transmission of images is high, so the bank does not make the images available to all terminals on the network. This is particularly relevant to Advance Bank which is a supermarket type bank. Also the higher the resolution of the image, the greater the cost of optical storage and 200 to 400 dots per inch is considered satisfactory. Each bank has its own security arrangements but this has not been a problem to date.

With powerful PCs and digital transmissions, it is possible to handle video images with voice and data or graphics at the same time. Examples of cost saving are that bank staff need not travel to head

office for training. Innovative ways are open for banks to use multimedia for fresh applications, to interact with customers wherever they have access to a computer.

Two further areas of benefit result from new ITs. The first is that it permits the downsizing of tasks from main-frame computer to mid-frame

"It will be possible for the bank's officers to work from home or the car and some staff will become part of the bank's workforce as commission agents, brokers, etc."

"Innovative ways are open for banks to use multimedia for fresh applications, to interact with customers wherever they have access to a computer."

computer, thereby freeing up system capacity and reducing capital costs. The second is that the speed of telecommunication transmissions has increased sixfold in the last six to eight years – from 9,600 bits per second to 64,000 bits per second – whereas the cost of the higher speed lines is only marginally greater. New digital transmission techniques have accelerated the exchange of electronic trading and electronic data, with significant cost savings.

In the area of mobile telecommunications Telecom started a pilot public radio packet data network for the Sydney region in December 1993, and will commence national expansion in 1994. This network is totally separate from the existing mobile cellular network and will enable people to have wireless access to their corporate applications, including access to information services through the use of hand-held terminals or notebook computers. It also permits two-way paging and electronic messaging.

IMPORTANTLY, AS THE NETWORK IS packet rather than circuit switched, charges will be based on information traffic volumes rather than connection times. Furthermore, because Australia and Asia have been later in introducing this technology than Europe and North America, we will have the advantage of not having to adapt to old systems and will benefit from their mistakes. We will have the most advanced network in the world for networks of a similar protocol. For the banking industry, this is an added advantage because the network can carry up to 200,000 packets per hour with an undetected error rate of less than 1 in 4.3 billion.

A whole range of personal digital assistants (PDAs) such as the AT&T EO 440 Personal Communicator, incorporating a built in cellular fax modem as a standard fitting, and mobile PCs such as the IBM ThinkPad, will make it possible for the bank officer to interact with the customer in different ways. The loan

officers will be able to visit the customer at the customer's site and have all the relevant information at their fingertips. These PDAs and PCs have been called the 'road warriors' of the future. It is likely banks will specialise in 'core' banking and backroom activities at the office, but many processes will be freed up by the mobile technology. It will be possible for the bank's officers to work from home or the car. Costly overheads such as office space and equipment can be cut back – and some staff will become part of the bank's workforce as commission agents, brokers, etc. Some recently retired bank staff may be employed for specific tasks or at peak demand in flexible and innovative ways, thus preserving their valuable experience. All banks are examining their options closely on investing in these mobile communications and multimedia systems.

Because of the shift from paper to electronic funds transfer, it has been necessary to overhaul the payments system. On 2 December 1993, the Automated Clearing House was replaced by the Australian Payments Clearing Association (APCA), which will have responsibility for paper clearings, e.g. cheques; bulk direct entry payments; low value (retail) EFT payments, e.g. plastic cards, EFTPOS and ATMs; and high-value (wholesale) payments which normally involve bank warrants, electronic inter-bank transfers and the electronic register of government securities.

Disputes will be resolved by the Reserve Bank or the Australian Financial Institutions Commission (the main regulatory bodies for banks and non-bank financial intermediaries respectively). The revisions must pass the test of the Trade Practices Commission and will involve a review of the

"This network will enable people to have wireless access to their corporate applications, including access to information services through the use of hand-held terminals or notebook computers."

Cheques and Payment Orders Act, where paper clearance processes are replaced by electronic clearance.

Sometimes the law must be changed to permit the safe and secure operation of new technology in a banking environment. The introduction of plastic credit cards and ATMs are examples of where regulations had to be changed in all states before a national ATM network could be operational without jurisdictional and other problems.

What does the future hold? Banks will use their management information systems to provide better service to clients. They will also know which products are more profitable and which ones to eliminate. Clients will be billed on a user-pays basis as the costs of each type of service or product will be better known. Bank customers will be able to carry out a number of banking transactions from their home either through their touch pad telephone or their multimedia set-up, (eg. transfers, withdrawals, bill payments, passbook updating and statement-on-demand services) which will also reduce the load on branch staff. Bank staff will go much more to the customer, and the mobile communications will be seamless and global in real time. These last mentioned points have strong implications for what is termed 'the globalisation of banking' and also for 'cross-border marketing' – two of the catch-phrases of the 1990s.

These developments will evolve in the next 5 to 10 years and will have the tendency of reducing bank costs. With any new technology, there are also risks. The bank's backroom staff are always

working to ensure the integrity of their systems and that security and privacy are maintained, but one should be mindful that in the United States just one 'hacker' who let loose the 'Morris Worm' on the banking industry cost that industry an estimated \$US97 million. ★

References
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Overchoiced and undersold

HE JUST WANTED "AN HONEST, ordinary desktop fax". Alright, I said, but this isn't going to be simple. Document feed? How many pages? Guillotine? Auto redial? Grey scale? Memory storage of how many numbers? Size of paper roll? Polling? Why not a fax modem? I could hear his breathing slowing. Oops, I'd passed the 'overchoice' mark back at document feed.

'Feature-itis' still plagues most products and marketing messages of the IT industry. The result? We have 20 choices of features on a fax, before we even get to brand choice. The same is true for computers. Consider the consequences. With so many options, there is no longer a single 'right' choice that is obvious. Therefore, brand loyalty isn't as strong. The more options we have, the more tenuous our commitment

becomes to each one. The purchaser seldom gains that comfortable committed feeling. They don't even know they bought the features they really should have. "Did I get a deal?" Who knows?

Faced with a million options, customers often take the safest path: do nothing, or delay. Computer salespeople know that response. But just how much do they really want to know about faxes or photocopiers? Answer: "Just enough to make the best decision for me." It's difficult. Making the best choice would require an elaborate prioritising of features, then setting dollars against each benefit. This could turn into a massive day-long spreadsheet analysis. Just to buy a fax machine? So the buying decision may be 85% devoted to feature selection, with the brand only being selected at the very end.

Entire new markets for 'de-mystification' have emerged. Call it just-in-time education. You ask for it when you need it and you get it when you want it. You learn it as you need to know. Education empowers your prospects to make their own decisions.

The IT industry is ripe for just-in-time education. Consider the jargon that surrounds fax modems: stop bits, DTEs, MNP5, Hayes compatible, Group III, v32.bis and baud rates. Despite the need to know all this, people don't want to know all this. Is it any wonder why someone would put off until tomorrow?

To deliver just-in-time education, companies can take advantage of services such as Fax-on-Demand. Call a specific fax number from your fax machine to get information and graphics for what you need at the particular time; for example, instructions servicing, or to get a specification sheet on a new model, even timetables and maps. Telecom has just concluded its Melbourne trials and is launching this as a nationwide service. The caller to a 1-900-xxx-xxx phone number will be able to get information they need on an at-needed basis, 24-hours a day – either

recorded messages, or live advice, or data. The caller gets the charge on their regular phone bill, with fees ranging from 70 cents per minute to \$5.00. Imagine the range of professional and advice services which are profitable at \$300 per hour. Fixed fee rates are also available, so the total call irrespective of length might cost from 35 cents to \$30.

What about TV-delivered education? The growth of TV delivery systems – satellite, microwave and fibre optic – allows much more specialised programming on many more channels. Hospitals were some of the first closed-system users, training their doctors and nurses while also delivering patient education and entertainment. By early 1995, offices or whole industries might be targeted for special educational programming.

New markets demand a new language. The old marketing language delivered the message, "Trust us, we'll tell you what's best to do". In psychological terms, it adopted a parent-child stance in talking to the customer. The new marketing language adopts the stance of adult-adult. It recognises customers are making their own choices; therefore the focus is helping the customer make a more informed, confident decision.

There are abundant opportunities in the IT market for de-mystification. Take the following steps: 1) Revisit your firm's mission: how might it become a 'demystifier.' Companies must increasingly see themselves as learning facilitators – training prospects to understand feature benefits. 2) Identify the just-in-time education needs of your prospects. Explore their concerns, self-doubts and decision processes. 3) Couch your marketing language in the adult-adult stance of empowerment. No matter what your business category, you must be in the business of customer education. Don't let your customer get overwhelmed by overchoice. This is the challenge and opportunity for leadership in the next few years. ★

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Phone politics: making telecommunication policy

The course of Australia's telecommunication policy over the last 25 years has been a deeply political process in which successive Australian governments have struggled to come to grips with technological change. Politicising the changes, however, makes it hard to objectively discern the benefits of policy decisions such as deregulation.

SOPHISTICATED TECHNOLOGICAL systems (eg. banking, the telephone) are an integral part of the way we live and structure our lives, yet we hardly notice them. On the other hand, Australia's poor record of developing and exporting home-grown technology is a constant reminder that technology comes from "somewhere over there" and we are powerless to alter its direction. For most Australians, the massive changes which have been heralded in high technology and communications over the past decade must seem just part of the inevitable march of technological progress.

In this view of the world, politics does not figure prominently since it is the inner logic of technology which drives change. If anything, politics is just an aberration or hiccup in the natural order of things that has to be overcome or managed so technology can continue to progress on its autonomous way. However, this view – which gives little role to politics – must itself be seen as highly political, preventing us from understanding or appreciating the political role played by technology in Australian society.

At the very core of technological change is politics. Choices about technology, how it is regulated, marketed and politically sold are being made daily in Australia by large private and public

corporations, governments, and at times even consumers. This affects who benefits and loses from technological change. The recent history of technology policy and telecommunications policy development in Australia provides an excellent demonstration that technological change has been shaped by a myriad of political forces. Any of the outcomes could have been different but once decisions are taken certain technologies can become entrenched and difficult to change.

Three phases in the recent history of Australian technology policy making can be identified. The first, from 1970 to 1975, set in place many of the preconditions for events which were to follow. The second, 1975-82, saw the Fraser Liberal Government espouse a non-interventionist approach in the market but with increasing political tensions relating to high technology and telecommunications. The final phase, 1983-92, is when the traditional monopoly arrangements for telecommunications underwent considerable change.

The 1970-75 period can be best characterised as one where the Australian Government

was being faced by an increasingly uncertain national and international economic environment. Australia was only just beginning to learn how to manage its science and technology resources, as it only created a Department of Science in 1972. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) at this time was the most dominant government research and development agency but its focus was agricultural research. On the world scene, industrial R&D and technology was becoming critical to competitiveness, but in Australia nearly 80 per cent of all R&D was still carried out by government.

The lack of interest by Australian industry in new technology and research was not surprising, given that these issues at the time were subsumed within a liberal regime of tariff protection. In telecommunications, a world-class network had been built up under the monopoly of the Post Master-General's Department but, with the adoption of satellite technology in countries like the US and Canada, Australia was being forced to face up to a rapidly changing international technological and economic environment. The creation of Telecom Australia in 1975 set in place a structure for dealing more dynamically with these new issues but Telecom's focus remained on engineering excellence and the provision of a universal telephone service.

The period 1975-82 was characterised by a turbulent interaction of technology and politics. Telecom's monopoly of the telecommunications

network was bringing it into conflict with business, which wanted a share of this growing and lucrative market. It was during the late 1970s, as a result from pressure by private business interests, that plans were made for Australia's national satellite system (AUSSAT). The decision to press ahead with the

"The recent history of technology policy in Australia provides an excellent demonstration that technological change has been shaped by a myriad of political forces."

expensive satellite system, with hindsight, laid the foundation for the later break-up of Telecom's monopoly. AUSSAT was never allowed to compete with Telecom for telephone traffic and as a result it began to generate massive debts for its government owners during the late 1980s. Technological enthusiasm had overwhelmed concerns expressed about the economics of the satellite venture or indeed its need. Pressure from industry for a competitive telecommunications market continued, but resistance from Telecom and the unions, together with a Labor victory in the 1983 federal election, helped to stall this process.

While Telecom was grappling with change and the prospect of a new regulatory environment, developments in the high technology sector (largely computing) were causing problems for government. During the late 1970s, the Federal Department of Productivity promoted the view that industry would benefit from the introduction of new technology. However, the spectre of a 'computer holocaust' of jobs was also given wide coverage at this time. The result was an intense national dispute during 1977 between Telecom and the unions in the telecommunications sector which severely disrupted the country's telecommunications services. The image of technology was portrayed by the Government as a progressive force within Australian development.

In 1980 the Liberal Government established the Committee of Inquiry into Technological Change (CITCA), which effectively steered the damaging debate away from the undesirable effects of new technology by asserting the inevitability of technological change and its employment generating effects. The battle over AUSSAT and the threat of the computer revolution to jobs effectively meant that two strands of policy activity – science policy (which was increasingly

concerned with technology) and telecommunications policy (which was starting to address the issue of Telecom's monopoly) – were being forced into common political terrain. This happened whether the bureaucrats responsible for these policy areas were prepared for it or not. During 1975-82, technology had become an integral part of policy making for promoting economic development. The pressures for change were however different in the two areas. Within telecommunications policy, technological change (eg. satellites) led to the Telecom monopoly coming under serious scrutiny. Within science policy, the increasing and effective lobby growing around high technology and information technology forced the government to address the impact of science and technology on industry and society (through the CITCA report).

THE PERIOD 1983-92 CAN BE characterised by concern with high technology development and active attempts to reconstitute the existing monopoly arrangements for Telecom. High technology 'sunrise industries' became an important part of the Hawke Labor Government's first term of office. The 'sunrise industries' were supposed to create new industrial and employment opportunities for Australia – a program of national recovery and reconstruction. Expectations were raised but the 'high-tech boom' was to collapse badly with the stock market crash in 1987. While political emphasis on high technology as a savior for Australia's economic woes diminished from 1984 onwards, the result was a much heightened appreciation of technology. State governments took a greater interest in the promotion of technology (eg. the investment in

"Telecommunications must be seen as integral to the organisation of centralised political power in Australian society."

technology parks during the 1980s).

The Labor Government's preference for greater competition and micro-economic reforms was to have its effect in

telecommunications during the late 1980s. In May 1988, the Government introduced a wide package of reforms designed to make Telecom more business-oriented and introduce a higher degree of competition into the market. Continued pressure from industry and an increasing debt from the AUSSAT satellite led the Government into fundamental structural reforms of the telecommunications industry in 1990. This was the period where the 'deregulation' of telecommunications was heralded as a great boost to the consumer and to industry. Prime Minister Hawke said at the time:

"We will see massive new private investment in the Australian economy: and expansion – not a contraction – of total jobs: a fall in STD prices on major trunk routes by as much as 40 per cent; and the creation of substantial and enduring export opportunities".

Telecommunications became the symbol of progress and efficiency, whereas a few years earlier it had been high technology. The result was that Telecom lost its monopoly and a new privately-owned company, Optus Communications, was allowed to enter the market. The debt-burdened AUSSAT satellite was privatised and taken over by Optus. Under the guidance of an industry regulator, the Australian Telecommunications Authority (AUSTEL), the telecommunications industry was set a target to attain full competition by 1997. Since the momentous decision to privatise AUSSAT and permit competition (which required a special conference of the ALP in 1990), serious consideration has been given to privatising Telecom. However most attention has focussed on reintroducing new regulations into the industry following the changes of deregulation. Typical issues have been over privacy, interconnection between

"Australia's bureaucratic structures are still considerably fragmented in key areas of industry and telecommunications policy and this could prove detrimental in the long term."

carriers and pricing arrangements.

In summary, during 1983-92 high technology, and more recently telecommunications, have become progressive symbols of the Labor Government's agenda for recovery and reconstruction (during 1983-4) and micro-economic reform (during 1987-92). The present competitive arrangements for telecommunications are a reflection of the central role that innovation and new technology are perceived to play in this strategy. What has occurred under the guise of deregulation must be seen as a process involving reformulation of the structure and organisation of telecommunications so as to incorporate the demands of international economic conditions, declining national economic fortunes, pressures from industry and other social demands (eg. maintaining employment).

What observations can be made from this brief historical overview? First, the complexity of change that has occurred in Australian telecommunications and technology highlights its political nature. There is much more than an 'inner logic' of technology involved. Governments, government agencies (eg. Telecom Australia) and large corporate interests were active in shaping the technological and regulatory environment. Consequently, telecommunications must be seen as integral to the organisation of centralised political power in Australian society. The struggle over deregulation in telecommunications was not driven by technology but rather was a manifestation of different interests attempting to change things in their favor. Technology was, of course, important in this struggle.

Second, the broader historical perspective allows for seeing deregulation and the evolution of technology policy as part of a specific stage of the economic development of Australia. Information creation, transfer and storage activities are now an important part of the Australian economy and

the convergence of change affecting technology and telecommunications reflects the differing ability of governments to accommodate this new mode of development. Just how well these changes are managed could affect Australia's economic performance relative to other countries.

THIRD, AUSTRALIA has followed overseas trends in telecommunications (eg. in the UK, US and Japan) by placing greater emphasis on technological innovation, market opportunities based on new services, and international competitiveness. The political consequences of this process of deregulatory reform are less than certain. For example, telecommunications, like high technology before it, has been symbolised by governments as necessary for economic competitiveness. However, such symbols can do much to prevent us from analysing who benefits and loses from technological change.

Fourth, it is evident successive Australian governments have been involved in a learning process with respect to technology and telecommunications policy. Government involvement in high technology during the 1980s proved less successful and now telecommunications has become the latest area of fascination. The ability of governments and industry to learn from and exploit these changing conditions will

determine success in the international marketplace. However, Australia's bureaucratic structures are still considerably fragmented in key areas of industry and telecommunications policy and this could prove detrimental in the long term.

Fifth, unintended consequences seem to have influenced Aust-

"Many political consequences have been 'forced' upon us from outside. However, this should not prevent Australia from developing ways to monitor and influence the essentially political process of technological change."

ralian policy in a significant way. For example, the escalating debt of AUSSAT contributed to putting structural change in telecommunications high on the political agenda. Likewise, simplistic adherence to models of policy development (eg. deregulation) may well have prevented truly national responses developing to Australia's peculiar conditions. This could have prevented the development of sophisticated approaches to national industry development and securing international markets.

In conclusion, it is evident technology is a persistent theme running through telecommunications reform and Australia is experiencing a learning process in dealing with telecommunications and technology in general. However, technological change must be seen as incorporating much more than technology-driven change. Key decisions have been shaped by governments and private and public institutions. Often unintended consequences will play a role in affecting what technologies or regulatory framework are adopted. The pattern of technological change is peculiarly Australian but it must be remembered that Australia is part of an international economy.

In this respect, many political consequences have been 'forced' upon us from outside. However, this should not prevent Australia from developing ways to monitor and influence the essentially political process of technological change. Nor should it prevent ordinary Australians from recognising that the technologies on offer in the market today are not there as a result of the inner logic of technological change but rather the outcome of a complex set of political forces and decisions. ★

A fuller discussion of these issues by the author is contained in Prometheus, Vol II, No 2, June 1993, pp. 252-270.

"The decision to press ahead with the expensive satellite system, with hindsight, laid the foundation for the later break-up of Telecom's monopoly."

Anti-advertising advertising

At this price, it will surely take your breath away.

At last, an automobile worthy of the times. The style, the statement, are sheer extravagance. No expense has been spared, no detail overlooked.

A timeless pleasure, the Apocalypse™ boasts unheard of standard features like pollution-related cancer, respiratory and heart disease valued at \$103 billion each year, automobile injuries and related expenses of \$394 billion, and indulgences like gas and auto subsidies, lost time due to congestion, and road construction and maintenance, lifting this impressive little number by some \$927 billion

a year. Still, what good would all these wonders do, if not for the delightful pleasures which have earned this car its name. For example, a guaranteed petroleum supply, most years a bargain at \$30 billion or so, but courtesy of the Gulf War, now over \$150 billion.

And what would the Apocalypse be without the greatest extravagance of all. Introducing The Apocalypse Payment Program (APP), conveniently allowing you to defer your payments to your children, and to their children after that.

\$250,000*



APOCALYPSE
The Ultimate Extravagance.

David Eyre

A crushed and mangled car is on TV. Suddenly it becomes two crushed and mangled cars, then a creaking, precarious dinosaur made of mangled, crushed cars stomping across the screen, howling in rage and pain.

'Its coming', a deep advertising voice says 'The end of the automotive age'.

The ad, *Autosaurus*, is the latest offering from the radical Vancouver-based media group, Adbusters.

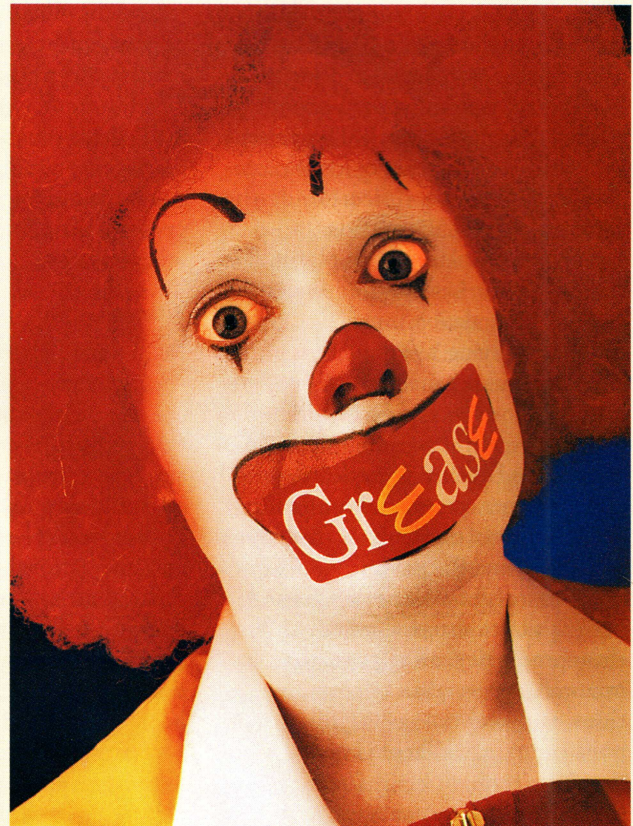
Master-minded by an ex-copywriter, Kalle Lasn, Adbusters is dedicated to turning advertising on itself in a no-holds-barred attack on the forces of consumerism, media manipulation, and environmental degradation.

Other TV ads produced by the group include *American*

Excess: leave it at home, The product is you, TV violence, Snap out of it America, and a talking rainforest ad where a old tree tells a young tree "unless something is done, soon big old trees like me will be just a memory".

And if you're thinking these are lame affairs produced by well-meaning woolly jumpers, think again – the ads are slick, hip and effective.

The only problem is getting them broadcast. *Autosaurus*, described by Lasn as part of "a pincer strategy for de-marketing the automobile", outraged car industry sponsors when it was run last year on the Canadian car show *Drivers Seat*. The Canadian Broadcasting Commission, CBC, subsequently banned *Autosaurus* on the grounds it was an advocacy ad, declaring that *Drivers*



Seat is "a news and information program on which advocacy ads are not permitted". Auto industry ads are not considered advocacy ads.

Lasn, 51, who was raised in Australia and trained in advertising in Japan, says CBS's refusal to run the ad attracted major publicity throughout North America, stimulating debate about lack of democracy in the media and the future of the car industry.

He says *Autosaurus* cost just US\$8000 to make as most of the film, sound and animation costs were donated. Adbusters, also known as the Media Foundation, receives donations which it uses to buy space in the print and broadcast media. Even when refused, says Lasn, the ads can be potent campaign tools. In 1989, the group killed a US\$7

Subversive print advertising by the Vancouver-based media group, Adbusters.

million forest industry campaign, arguing that since it was advocacy advertising, they had a right to run an advocacy counter spot. Rather than run the counter spot, CBC canned the pro-logging ads.

Lasn says that by the age of 20, the typical North American has seen 800,000 ads on TV. "The commercial media can be seen, in a way, as our biggest environmental problem. Every 12 minutes, it's saying Buy! Buy! Buy!"

Has Adbusters plans for Australia? Lasn, who was in the country last year says maybe: "We have chapters starting up all over the world...we are happy to make our resources and expertise available". ★

Modern menarche rituals inadequate

A recent US study has found that contemporary teenage girls may be less prepared for sexual maturity than at any time in the last century, as menarche has changed from a rite of passage to an adolescent hygienic crisis requiring a host of sanitary products. "To some extent, the rite of passage for American girls has been transformed from a mother-daughter dialogue about the female body to a commercial activity of purchasing sanitary and grooming products," says director of the study, Professor Joan Jacobs Brumberg of Cornell University.

Brumberg, who has conducted extensive analysis of girls' diaries dating back to the 19th century, says that in the western world, menarche now has little to do with adult sexuality or adult status. Industrialisation and public advertising, however, have helped demystify menarche by bringing women's bodies more into the public realm. But although modern menarche has no flamboyant rituals, it is not culturally neutral. The way society openly discusses menstruation and teaches young girls how to manage the hygienic aspects of menstruation may be considered modern rituals.

In colonial times, says Brumberg, girls learned that menarche was the "bellwether of female fertility." By the Victorian era, however, "knowledge about menstruation was considered the first step on the slippery slope to loss of innocence". Girls were increasingly 'protected' from the message. By 1895, 60 per cent of high school girls were ignorant about their impending menstrual periods. Concurrently, girls were menstruating at younger ages.

According to Brumberg, in 1780 the average age at menarche was about 17; today, it is 12.5. By the 20th century, the "medicalization of menarche" and the belief that mothers were not adequately preparing their daughters for menarche led many middle-class girls and mothers to turn to books for information about puberty. Working-class mothers expected girls to learn from friends, sisters and fellow workers.

Brumberg says that after World War I and its outbreaks of venereal disease, the US embarked on a crusade to promote moral health in which all aspects of sexuality were sanitised, including menarche and menstruation.

The sanitary products industry boomed and by the 1930s and 1940s filled the menarche information void by providing corporate-sponsored pamphlets. Millions of girls learned about "desexualised" menstruation from these booklets and even from a Walt Disney animated film that was seen by about 93 million American women. ★

US cuts foreign aid

The US is cutting back on aid – since the Marshall Plan an established means of obtaining leverage. The US Agency for International Development (USAID) has announced that over the next three years it will close or consolidate field missions in 35 developing countries to achieve savings around US\$50 million annually. Interestingly, some of the funds saved will be re-channelled through non-government organisations, the global influence of which has increased dramatically over the last decade.



Best-selling machine gun

Russian inventor of what is arguably the world's deadliest firearm, the AK-47 machine gun, Sergeant Mikhail Kalashnikov, last month told Britain's Weekly Telegraph: "I wanted my invention to serve peace, not to make war easier. If the politicians worked as hard as we did, the guns would never have got into the wrong hands". The AK-47 (Automatic Kalashnikov 1947) can spray 30 bullets in three seconds and inflict a fatal wound at 270 metres. Light enough to be used by a child and reliable when dirty, wet or unoled, it is the first choice of rebels, terrorists and mercenaries. Cloned in dozens of local factories, from China to the former Yugoslavia, it is estimated 50 million AK-47s have been made and distributed in post war years at black market prices as low as US\$100.

Robocop

Taiwan streets are now being patrolled by prototype \$225,000 mechanical 'Robocops'. The remote-controlled robot policemen are armed with machineguns, a stun gun and teargas shells.

A Palestinian militant armed with a Kalashnikov machine gun.

Videodrug and videogod

Videodrug, a series of music videos designed to simulate the effects of taking narcotics, is the latest craze among sensation hungry Japanese youth. Videodrug has proved so popular that it has given rise to sequels, most notably Videogod which uses the same principle to create a religious-spiritual experience.

Passenger-free, talk back tram

You won't be able to ride on it, but Melbourne is to have a multi-media, play-back tram. This postmodern giddiness, the development of which is being funded by the Australia Council, will randomly circulate Melbourne's 220 kilometres of tram tracks, 24 hours a day, recording visual and acoustic data and playing it back through a large, double-sided screen. A dominant theme seems likely to be the protestations of disgruntled would-be passengers. ★

The High-Definition Olympics: HDTV and Sydney 2000

Kent Wildish

Viewers of the Lillehammer Winter Olympics were thrilled by the spectacle of the luge, ski jumping and other events. Birds-eye and helmet mounted cameras now bring TV coverage "more real than being there". How can coverage of such events improve? Hold on to your armchairs: HDTV is on its way, bringing cinema quality images into your lounge room – and the Sydney Olympics could hasten the introduction of digital high-definition television (HDTV) for Australian viewers.

For as long as there's been television, the Olympics have been the world's premier TV event. The 'TV debuts' at Olympics are as impressive as any other chronicle of Olympic records: black-and-white world debut (Munich, 1936); Australian debut (Melbourne, 1956); color TV European debut (Grenoble, 1968); HDTV/MUSE world debut (Seoul, 1988); HDTV/HD-MAC world debut (Albertville, 1992).

More HDTV debuts are bound to follow: the two demonstrated HDTV formats, MUSE and HD-MAC, are analog broadcast systems, but this year the US Federal Communications Commission decreed that HDTV transmissions in the US will follow a digital format (broadcasters will simultaneously transmit programs in the familiar NTSC format for consumers with older sets).

Digital transmission has yet to be proven, although four US developers have established the compression techniques necessary to cram digital HDTV into the 6 MHz broadcast channels available in the US.

Currently, Japanese HDTV

receivers carry price tags in the tens of thousands of dollars. The price, along with the dependence on outdated analog methods, will ensure that the MUSE system is not widely introduced in the near future – in fact NHK is backtracking somewhat, and pushing Enhanced Definition TV in Japan. EDTV monitors have wide screens, with only 525 or 625 lines. The image is often improved by decreasing flicker, but they only cost a little more than conventional sets. A similar system called PAL-plus is due to be introduced in Europe in 1995, and enhanced or 'improved' definition sets are already available in Australia.

These factors, along with heavy investment in digital research, prompted a recent claim by Philips that digital HDTV would bring stunning



PHOTO: SONY AUSTRALIA PTY LTD

improvements to Australian home TV viewing before the year 2000.

MIT Media Lab director, Nicolas Negroponte and Next Inc's Steve Jobs (of Apple fame), are more sceptical. As early as 1989, they argued that HDTV was hardly worth bothering about, as it could

What is HDTV?

Japan's national broadcaster, NHK, began researching high definition TV in 1968. Research showed that viewers preferred a screen aspect ratio (width: height) similar to that seen in cinemas, and that doubling the number of horizontal lines in the picture gives the best possible definition.

High-definition receivers are characterised by a wider aspect ratio (16:9, as opposed to 4:3 for familiar PAL or NTSC sets) and have 1125 or 1250 horizontal lines. They typically have 720,000 pixels, where PAL sets have around 120,000.

NHK began broadcasting using its analog MUSE (Multiple SubNyquist Sample Encoding) format in 1988, with eight hours of programs a day from 1991.

A European consortium, led by Holland's Philips and France's Thomson, developed a second analog format, HD-MAC (HD-Multiplexed Analog Components). Founded on MAC, which was a European Community initiative to unite incompatible PAL and SECAM standards, HD-MAC was subsequently abandoned when EC strife stopped MAC from proceeding.

In the US, rival consortiums of General Instrument/MIT, Sarnoff/Philips/Thomson/NBC, and Zenith Electronics/AT&T have been working on the 1050 and/or 787.5 line formats.

The reason for the variation in number of lines is that the formats are based on multiples of 1.5 or 2 times the current standard number – 525 in the US, Canada and Japan, 625 in Australia, NZ and Europe.

The wide-screen format of HDTV: coming to Australia by the end of the century.

soon be overtaken by developments in computer screen technology; after all, the digital transmissions could be shown on high resolution computer displays as easily as TV sets.

Similarly, many would wish to wait for advances in flat screen displays. Currently, large flat screens are hampered by problems with brightness, viewing angle and distance, and manufacture.

Some even question the future of broadcast TV as we know it, citing the potential offered by networks and the much-vaunted information superhighway.

However, given the uncertainties associated with getting most of these alternatives to the market and the vested interest in HDTV, it seems likely that serious attempts will soon be made to introduce it. For one thing, HDTV cameras and outdoor broadcast and editing vans have already been developed for live transmission. Other high resolution systems would need similar equipment to compete for the live market. ★

Federal funding for collaborative research

In 1994, researchers at Australia's top universities and institutes will share more than \$12.5 million through the Federal Government's Collaborative Research Grants program. The program, which encourages greater interaction between higher education and industry, will provide \$6.25m to 85 new projects and \$6.31m to 95 ongoing projects.

Grants are made on the basis of their potential economic and social benefit to Australia, the quality of researcher or research group and clear evidence that the project will be truly collaborative. Industry matches the

government contribution dollar for dollar. The average size of the grants is \$73,600 but some exceed \$200,000.

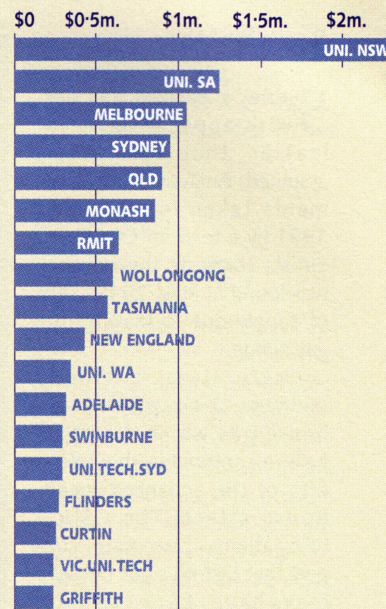
Between them, NSW and Victorian institutions will receive over 70 per cent of the funds. The biggest winner is the University of NSW, with 15 projects at a total of \$1,374 million.

Among the projects to be funded are research into:

- hybrid human cells to manufacture materials called monoclonal antibodies which could be used to diagnose, treat and prevent specific diseases such as cancer and possibly AIDS (University of NSW)

- development of an integrated software environment on a supercomputer platform for land management systems (University of Queensland)
- formulation of environmentally benign industrial degreasing solvent blends from sustainably produced tree crops (Murdoch University)
- production of new low allergen ryegrass cultivars (University of Melbourne)

Collaborative Research Grants awarded to higher education institutions in 1994



Gratuitous gadgets

Merran White

Inventing gratuitous gadgets is almost a national pastime for the Japanese – so much so that they have a club, the Japanese Chindogu Society (*chindogu* roughly translates as 'gadget of dubious quality'), which boasts thousands of members, all dedicated to dreaming up dodgy inventions. Here is a sample of the latest offerings:

- a battery powered spinning fork that takes the effort out of eating pasta
- a porta-desk that hangs on a strap round your neck so that you can type, take memos and doodle while standing in transit
- a portable, suction-cupped strap that you can whip out when the subways get too crowded
- a robot priest, to compensate for the current shortfall of Buddhists available to perform traditional funeral rites: the

robot can chant up to 10 different Buddhist sutras, blink and move his mouth

- 'Puss-in-boots' mop attachments that let your cat clean the floors
- a hi-tech police truncheon that can write messages in the sky – the 'sky-writer', invented by an Osaka-based police officer, enables temporary commands such as Halt, Pull Over or Help, to be written in light
- a robot martial artist that's six foot tall, weighs 12 stone, and best of all, doesn't fight back

But the Japanese have rivals in the field of Chindogu. Where in the world could you buy floating chairs and tables, filled with lighter-than-air gas? You guessed it, California. The highly priced designer furniture is apparently the flavor of the month at elite parties.

Also from America comes: the best phone gadget ever: Bouncer, a device that lets you screen calls to the maximum –



PHOTO: ANGELI

Parking is not a problem with this 35kg vehicle, though lugging it up stairs might be. Mazda's fantasy prototype, the suitcase car, folds down into medium-sized suitcase in a minute. Its 1.7 horse power engine allows a cruising speed of 20km/h.

just program your 'reject' phone numbers in and the Bouncer automatically hangs up on them.

- the ultimate in 'quickie' divorces. Quickcourt, a pilot computer program currently being trialled in Arizona, takes around 30 minutes to guide you through the unhitching process via a Q&A cross examination. If your application succeeds, the computer

churns out official, legal divorce papers.

- computer screen-saver ads – now you can watch preview publicity for the latest blockbuster on your screen every time you stop typing. Last year, Universal's *Jurassic Park* on-video-screen-saver did big business; now the Flintstones are filling idle screens all over the States.

★

Sydney's methane problem

Brett Wright

Sydney's natural gas network appears to be far leakier than previously assumed. Analysis of measurements taken in 1990 and 1991 by a team of CSIRO scientists suggests the network was losing at least 20 per cent of supply due to leaks in the gas piping.

Natural gas is chiefly methane, a powerful greenhouse gas which scientists believe contributes about one-fifth of the enhanced greenhouse effect. The CSIRO calculations, if accurate, suggest that Sydney's gas network may have been leaking methane to the atmosphere at a rate of more than 155,000 tonnes a year, and still may be losing as much as 80,000 tonnes a year.

The Natural Gas Company, which runs Sydney's gas supply, does not accept CSIRO's figures, and prefers its own estimates, which are substantially lower.

Despite the disagreement, however, the company is spending \$400 million to upgrade the network. Its 'Goldline' project is progressively replacing old, corroded cast-iron piping with nylon pipes.

Begun in 1990, the upgrade has reduced leaks, according to the gas company's calculations, from about 11 per cent to under six per cent today.

But even six per cent is high by world standards. If that figure is overly optimistic, as the CSIRO study suggests, then a question arises: will the Goldline project cut methane emissions to acceptable levels?

CSIRO's estimates are based on a sophisticated analysis of the isotopic variations in the urban air. A small



Repairing Sydney's leaking gas mains.

number of samples collected by aircraft over Melbourne and Sydney in 1990/91 showed marked differences in the proportions of carbon-13 and carbon-14 isotopes in the methane (CH_4).

Carbon has three naturally-occurring isotopes: ^{12}C , which comprises 99 per cent of all carbon; ^{13}C , which comprises about 1 per cent; and the radioactive ^{14}C , which occurs in minute amounts in air, water and living things. ^{14}C is produced in the atmosphere by the interaction of carbon with cosmic rays. If a sample of carbon is isolated from the atmosphere or ocean, it gradually loses its ^{14}C by radioactive decay. The methane in natural gas and other fossil fuels, which are extracted from deep in the earth, contain no ^{14}C because it has all decayed.

The stable carbon isotope ^{13}C also occurs in varying proportions in nature, depending on the source of the carbon. One of the main causes of the variation is that some of the bacterial processes that produce methane favor the ^{12}C atom over the heavier ^{13}C atom.

By carefully measuring the

proportions of ^{14}C and ^{13}C in a sample of methane, it's possible to determine where the gas may have originated.

In the air samples collected over Melbourne and Sydney, the CSIRO team found that Melbourne air contained less $^{13}\text{CH}_4$ and more $^{14}\text{CH}_4$ than Sydney air. That's because the methane in Melbourne air appears largely to have a recent biological origin – the sewage farm at Werribee, for example – whereas most of the methane in Sydney air comes from fossil fuel sources.

The difference between the two cities' methane is marked. Not only did Sydney appear to have higher emissions of methane than Melbourne, but the researchers estimated that about three-quarters of the Sydney methane came from fossil sources, compared with a quarter of the Melbourne methane.

Further analysis of the Sydney data indicated that 65 to 85 per cent of the fossil component was from natural gas, with the rest coming from coal mines south of the city.

The scientists conclude in their report: "We consider that

about 30 per cent of natural gas supply may have been emitted to the atmosphere in 1990, reducing to about 20 per cent in 1991. The reduction may well reflect the effect of upgrading the natural gas supply system."

Despite the significance of this largely preliminary study, funded by the Energy Research and Development Corporation, CSIRO has not received a brief to continue.

According to one of the researchers, Dr Paul Steele, "there is an urgent need to do more of these measurements, but we can't get any funding".

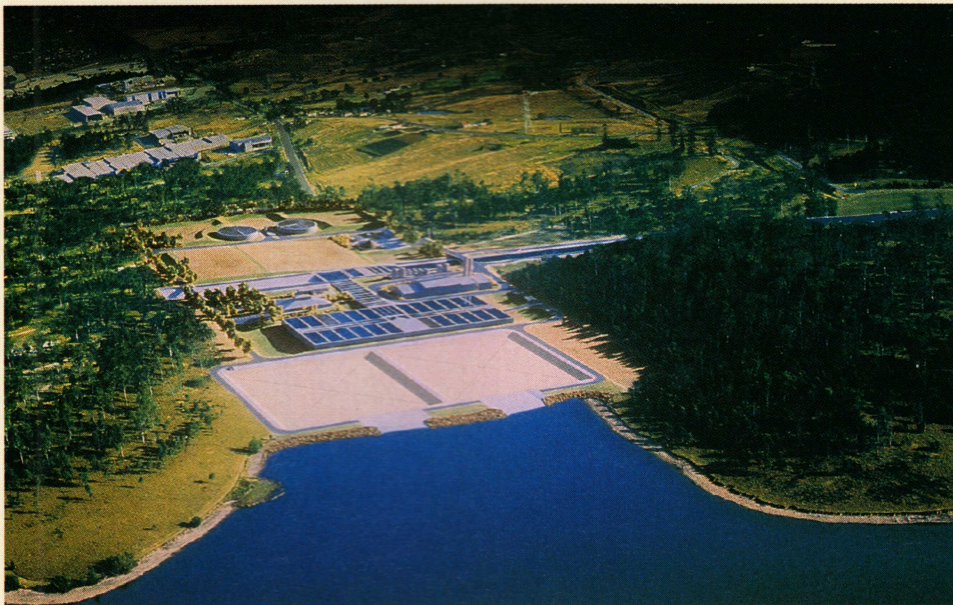
On the world front, the news is a little more positive. Researchers in the United States, Australia and Britain appear to have observed a dramatic decline in the growth rate of atmospheric methane in the Northern Hemisphere.

This does not mean methane concentrations have dropped, but the rate of increase appears to be slowing, and there is considerable likelihood methane levels will stabilise in the next 10 years.

The research team found that the growth rate in 1992 fell to less than 2 parts per billion (ppb) per year, compared with an average growth rate of 11.6 ppb in the years 1983-91.

Several causes are possible but the most likely is the plugging of leaks in the enormous gas pipeline built in the former Soviet Union in the 1970s and 80s. The pipeline was believed to be extremely leaky, but after a pipeline explosion killed 400 people in 1989, the Soviets called in Western gas companies to help reduce the leaks.

It is estimated that the repair work may have cut methane emissions by 15 million tonnes a year. ★



Private sector invests in water supply

The Southern Hemisphere's largest water filtration plant will be built, owned and operated at Prospect in Sydney's west by Australian Water Services under a \$200 million contract with the NSW Government. The plant, comprising 24 sand filters each the size of an Olympic pool, will supply up to 85 per cent of Sydney's drinking water after completion in 1996. Australian Water Services is a joint venture comprising one of France's largest companies, Lyonnaise Des Eaux-Dumez, Lend lease and P&O Australia. Managing Director Pierra Alla, says that the Australian water services market may grow to be a billion dollar industry.

Poor and polluted

Poor people are more likely to ingest contaminated food than the rich according to a study by the US body, Physicians for Social Responsibility. The study

A digital simulation of the Prospect Water Filtration Plant. The privately owned development will supply around 85% of the greater Sydney area.

found that three quarters of unsafe toxic waste disposal sites in the US are in impoverished black communities. To make matters worse, poorly fed people are more vulnerable to pollution because malnutrition weakens the immune system, increasing vulnerability to infectious pathogens and possibly to chemical agents.

Keep smokers away from your baby

An US study reported in the *Journal of Pediatrics* (October 1993) has found that second-hand cigarette smoke increases the incidence of respiratory illness in babies and young children.

The study eliminates the influence of smoking by the children's mothers during pregnancy. None of the 1,007 women in the study smoked. Previous studies have found

that children whose parents smoke have more respiratory infections, more respiratory symptoms, and an increase in hospitalisation for bronchitis and pneumonia. But researchers had been unable to separate the damage caused by environmental tobacco smoke after birth from the effects of maternal smoking during pregnancy.

The number of cigarettes smoked per household is also important. The study found that a one cigarette per day increase in consumption resulted in a four per cent increase in the 18-month risk of an infants being hospitalised for respiratory illness.

Rates of respiratory illness may also vary depending on the tar content of the cigarette, the household ventilation, and the amount of time children spend indoors. The study also showed that children who were breast fed for at least one month experienced fewer episodes of respiratory illness

than children who were bottle fed, irrespective of presence of cigarette smoke. Risk of respiratory illness to bottle fed babies nearly doubled.

Plantlife computer ID

Australian nurseries can now use a computer database to correctly identify plants and help with customer enquiries. Melbourne's Royal Botanic Gardens has developed the Greenlife Database to provide a quick cross reference of common and scientific plant names. A modified version, likely to be available to the public in 1996, will include information about plant cultivation and color pictures to aid identification. Details are available from Botanic Nomenclature Services on 063 619666.

Summit to save the tiger

Representatives of the 14 Asian States which still have tiger populations will meet in Delhi this month to formally establish a Global Tiger Forum to embark on a world-wide campaign to save the tiger. There are now only an estimated 4,600 to 7,700 tigers remaining in the wild. The two main causes for the decline of the species are organized poaching for tiger skins and bones for traditional medicines and destruction of the tiger's normal habitat due to human population growth and associated expansion of housing and agriculture.

For further information, please contact: Jim Sniffen UNEP Information Officer Nairobi, Kenya. e-mail: ipaunep@gn.apc.org. ★

The Music of the Mind: An Adventure into Consciousness

Darryl Reaney

Hill of Content \$19.95

Reviewed by
Rick Slaughter

Darryl Reaney's last book, *The Death of Forever*, was one of those rare books to succeed in weaving a genuinely new synthesis about the place of humankind in the universe. *The Music of the Mind* continues this theme and brings it to a triumphant conclusion.

The immediate difficulty for any reviewer confronting this material is how to do it justice. The author has written sparingly, with great focus and economy, of matters that cannot be readily summarised. So to understand Reaney's achievement, I cannot over-emphasise that it is necessary to read the book – not just a review. Work of this quality is rare. Many have tried to touch on the big questions of life, death, consciousness and meaning, but few have done so with such clarity, elegance and truthfulness.

Reaney understands the source of much of our modern malaise. "Society is sick," he writes, "because we have lost the 'story' that bound us together." So far so good. Thomas Berry and others have come to the same conclusion. He then proceeds to demonstrate how many of our beliefs and dominant ways of knowing have produced an impoverished view of reality. "Our problem as human beings is that the very way our minds operate depends on the principle of separation." Or again: "We have nourished a view of reality so impoverished it has crippled the very roots of our



The late Darryl Reaney

way of seeing...consciousness is much richer than this."

But this is no diatribe against modernity. The often sterile posturings of academic debate are sidestepped entirely. Instead, he draws on a range of sources to outline a richer view of reality. Paradox is part of his method, and like a Buddhist koan, he uses it to help us to reflect on hidden truths. Language is not all it seems: it is a thing of power and a barrier to knowing ... The brain is not the seat of consciousness ... While we are conscious in time we are not conscious at all ... Death is not an ending but a transition ... and so on. To even state these items baldly is to

risk mis-representing them, for this is not a tired re-write of holistic orthodoxy. It is a book which challenges us at a number of levels – thought, belief, experience, memory, being – to re-frame our view of our place in the world, and indeed, the universe.

In many ways he presents us with the essence of a 'new story', one that has been developing for a long time, but which can only now, in the late 20th Century, be told as the insights of eastern wisdom and quantum reality merge.

Each person will react to this book differently. I have one experiential confirmation of part of it. Some years ago I was unexpectedly bowled over by a healing I received at the Findhorn Community in Scotland. For a few moments I was immersed in an indescribable universal light, which was all-powerful, and entirely benign. It is no exaggeration to say that my view of reality was profoundly and permanently altered. For Reaney, as for many others who know the field, higher states of consciousness are seen as a royal road to awareness. Here he uses accounts of near-death experiences (NDEs) to show how these hints of the infinite ("ineffable light, transcendent love, an intuition of timelessness, the loss of sense of self") help to substantiate a more profound view of life, mind and being. Since perception is limited by the organic equipment nature has provided us, as well as by the cultural 'software' we use, such evidence does encourage a wider, more insightful view. And that is a valuable gift.

It would be a mistake to be put off by the subject matter. His conclusion (and it is by no means forced, it emerges centrally from the substance of the

work) touches the very heart of our contemporary dilemmas about personhood, meaning/meaninglessness and the looming global problematique. In his view, "we need no longer regard ourselves as accidental irrelevancies in a mechanical universe but as participatory co-creators of...an evolving work of art". And later, simply, "what we do matters". Since the 20th Century has moved to a very different tune, that is a message we need to hear – and apply.

Some may dismiss it as just another theory, a perspective or even a mythology. But to be dismissive is to miss the point. Reaney has seen the world in its agony, seen through the veil of appearances, and with enormous courage and discrimination drawn an interpretative map which points both higher and deeper than our conventional view. As such, this book is a profoundly valuable and heartening contribution to all our contemporary debates and dilemmas. It acknowledges the abyss we are collectively facing – and sees a path beyond it. Yet it is not difficult to read. There is no jargon. But, step by step, it brings the reader to a point where he or she cannot help but stand in awe of the achievement – and what it implies. Here are the outlines of a renewed worldview, a fresh vision, which decisively take us beyond the traps of the late industrial era.

Finally, a profoundly moving irony pervades the book. Darryl Reaney is no longer around to enjoy the appreciation it will no doubt generate. He died shortly before it was published. But part of his thesis is proved nevertheless.

His spirit inhabits these pages and his voice is therefore not stilled. ★

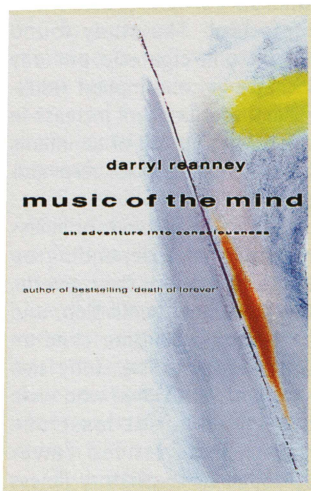




PHOTO: LINDA BROOME

The Mountain Pygmy Possum of the Australian Alps

Ian Mansergh and
Linda Broome

University of NSW Press
\$19.95

Reviewed by
Rosslyn Beeby

In 1966, a party of skiers at the University Ski Lodge on Mount Higginbotham in the Victorian Alps, captured a tiny animal with a prehensile tail that nobody could identify. They took it back to Melbourne with them where zoologists announced it was the first living specimen of *Burramys parvus* (commonly called the Mountain Pygmy-Possum or Burramys) seen by

Europeans. The 'mouse' with the prehensile tail, which subsequently found its way into the Guinness Book of Records as the rarest mammal on Earth, had long been presumed extinct. It was previously known only from fossil remains found in central NSW in 1895.

Burramys is Australia's only alpine mammal and the only true marsupial hibernator. Named from the Aboriginal burra burra (meaning place of rocks), the Greek "mys" (mouse) and Latin "parvus" (small), its scientific name means "small rock mouse."

This extraordinary creature made history again in 1989 when Australia's first wildlife tunnel was built under a busy road on Mount Higginbotham to allow males of the species

to cross safely to reach colonies of females. Dubbed the 'tunnel of love' by the media, it was an instant success. Cameras recorded animals using the tunnel within an hour of installation.

The book is both an eloquent plea for the preservation of one of our most endearing native animals and a thoroughly enjoyable read. It is also a scholarly work.

Zoologists Ian Mansergh and Linda Broome have recorded the life histories of over 1800 *Burramys* and their painstaking research forms the backbone of the text. Mansergh, who was chiefly responsible for the tunnel's design, has studied the possum since 1979 and is the author of over a dozen scientific papers on the subject. Broome, an authority on

***Burramys parvus*: Australia's only alpine mammal**

Burramys populations in NSW, also took many of the color photographs.

If Australia held its natural historians in the same reverence as the British, Mansergh and Broome would be feted as local heroes, appearing on chat shows and TV documentaries. We need to be more informed about our wildlife and their book is a welcome step in this direction.

The book also contains a sober warning. We cannot be complacent about the possum's future. A more responsible course of action and environmental restraint is needed by all Australians if animals such as *Burramys* are to survive. ★

The Birth of the Universe

The Universe began with a bang up to 15 billion years ago. Or was it 13, or eight billion years ago, give or take a billion? Dating the creation is crucial to our understanding of how it all began. Scientists are trying to determine the age of the universe from its current rate of expansion, and some estimates have it expanding more rapidly than previously thought, which is big trouble for the Big Bang theory. The Hubble space telescope is expected to provide the answers.

WHEN A TEAM OF ASTRONAUTS FINALLY FIXED UP the Hubble space telescope late last year they did more than restore the tarnished image of American technology. For decades scientists have been perplexed by a paradox that strikes at the very heart of cosmological theory: the existence of stars that seem to be older than the universe. With the telescope's vision now near-perfect, the way lies open for the resolution of this vexing conundrum.

Cosmologists have long believed the entire physical universe originated abruptly in a gigantic explosion known as the Big Bang. That the universe is still expanding today is the most direct evidence for the Big Bang. From the observed rate of expansion it is easy to work out that a few billion years ago all the galaxies must have been compressed closely together. This enables astronomers to estimate the date when the universe exploded into being.

The space telescope will follow the scientific trail blazed by the eponymous American astronomer, Edwin Hubble, who in the 1920s discovered the universal expansion. Hubble first helped establish that our Milky Way galaxy is not alone in the universe, but merely typical of a myriad of galaxies scattered throughout space. Turning his attention to other more distant galaxies, Hubble found that the farther away they were situated the redder their light seemed. By careful measurement of the spectra he was able to establish a simple numerical relationship between the distance of a galaxy and the reddening of its light.

The red shift, as it was called, led Hubble to conclude that distant galaxies are flying away from us at high speed. To make sense of this observation, astronomers appealed to the work of Albert Einstein, whose general theory of relativity was published in 1915. Ever since the time of Isaac Newton, scientists have recognised that the structure of the universe is controlled by the force of gravitation, which acts between all astronomical bodies. Einstein found that gravitation is best regarded not as a force at all, but as a warping or distortion of the geometry of space and time. In effect, claimed Einstein, space and time are elastic and can be stretched and shrunk, causing bodies to deviate in their motions as if being tugged by a force.

In the context of cosmology – the study of the overall structure and evolution of the universe – Einstein's theory predicts that the space between the galaxies can stretch with time, thus conveying them farther and farther apart from each other. The expansion of the universe can therefore be envisaged not as a dispersal of galaxies *through* space away from a common centre, but as a swelling of the space *between* the galaxies. Light from distant regions of the universe, in traversing the expanding void on its way to Earth, is also stretched, so increasing its wavelength. In the spectrum of visible light, red corresponds to long wavelengths, so the expansion of space produces the red shift observed by Hubble.

Einstein's theory of stretching space carries a profound implication about the nature of the Big Bang. If we could 'run the great cosmic movie backwards' then space would have been more and more shrunken in the past. According to the equations, at a certain moment, space would have shrunk away to literally nothing, and the universe would no longer exist. In other words, the Big Bang was not merely the coming-into-being of matter, but of space too. We can think of the initial state of the universe as one of infinite compression, in which the entire cosmos is squashed into a single point.

An equally fantastic conclusion can be made about time. The infinite timewarp created by the compression implies that time itself began with the Big Bang. Although this idea sounds bizarre and is almost impossible to visualise, it is far from new. In the fifth century St Augustine of Hippo declared that the world was made *with* time and not *in* time. If correct, it is then meaningless to ask what caused the Big Bang, or what happened before the origin of the universe, because there was no 'before'.

Many popular accounts give the erroneous impression that the Big Bang was the explosion of a compressed lump of matter located at a definite place in a pre-existing void. However, it is more accurate to say that the universe originated from literally nothing at all – not even empty space. It has no special centre away from which the galaxies are flying, and no edge beyond which lies only emptiness. The galaxies are not merely rushing away from us, but from

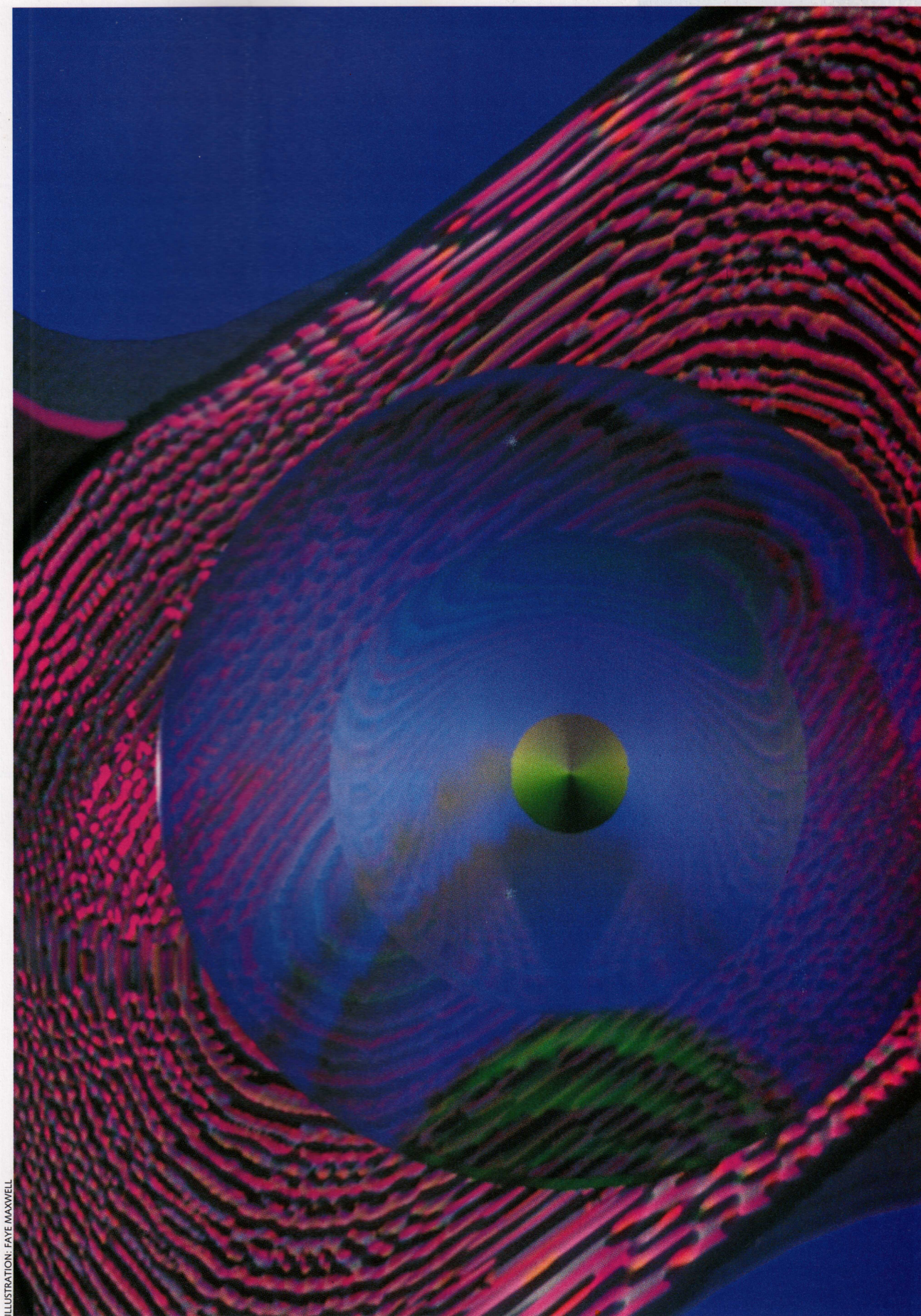


ILLUSTRATION: FAYE MAXWELL

"It is more accurate to say that the universe originated from literally nothing at all – not even empty space."

each other too, so that the pattern of motion would look more or less the same viewed from any galaxy.

Compelling though the Big Bang theory proved to be, it suffered from a serious flaw right from the start. Taken at face value, Hubble's red shift data suggested that the explosion occurred, i.e. time began, about two billion years ago. However, radioactive dating proves that the Earth is over four and a half billion years old, while a careful analysis of ancient stars in groups known as globular clusters suggests they are at least 14 billion years old. If the Big Bang was indeed the origin of the entire physical universe, these numbers are absurd. Clearly the universe as a whole must be at least as old as any of the objects within it.

Shortly after the Second World War, the Dutch astronomer Walter Baade announced that Hubble had made a huge error in his measurements, and that the galaxies in his survey were much farther away than he had estimated. This changed the date of the Big Bang from two billion to about ten billion years. While even this time scale is uncomfortably short as far as the stellar ages are concerned, many cosmologists were prepared to turn a blind eye to the difficulty and concentrate on finding additional evidence for the Big Bang theory.

Welcome confirmation came in 1965, with a chance discovery by two telecommunication engineers, Arno Penzias and Robert Wilson, working at the Bell Laboratories in the United States. Penzias and Wilson were testing a microwave antenna used for satellite communication when they noticed a strange background hiss. After exhaustive checks they concluded that the hiss was coming from outer space. Scientists soon realised that Penzias and Wilson had stumbled on nothing less than a relic of the birth of the cosmos.

The highly compressed matter created in the Big Bang would have been immensely hot. As the universe expanded and cooled, so the heat radiation gradually faded until today it bathes the universe in a soft glow of microwaves at a temperature of about three degrees above absolute zero (-273°C). It was this dwindling afterglow of the Big Bang that Penzias and Wilson found.

Once the primeval heat radiation had been detected, cosmologists were able to reconstruct an account of the events that took place in the first few minutes after the cosmic birth. At one second old, the temperature of the universe was 10 billion degrees – too hot for atomic nuclei other than hydrogen to exist. Instead, the primordial cosmic stuff must have been in the form of a soup of fast-moving sub-nuclear particles. Computer simulations suggest that prolific nuclear reactions occurred among these particles for a minute or two. After this, the temperature was too low for further nuclear

activity. The calculations predict that nuclear processing transformed about a quarter of the cosmic material into the element helium, along with a trace of deuterium. The rest was left in the form of the simplest element – hydrogen. These proportions match the observations well. Astronomers confirm that the universe is indeed made up of about one quarter helium and three quarters hydrogen, with just a tiny proportion of heavier elements such as carbon, oxygen, nitrogen and iron.

TAKEN TOGETHER, THE COSMIC EXPANSION, THE HEAT radiation and the abundance of the chemical elements, strongly implies the hot Big Bang theory is broadly correct. But several baffling mysteries remain, quite apart from the time scale problem I have already mentioned. For example, the background heat radiation provides a snapshot of what the universe was like shortly after the Big Bang. Scrutiny of the radiation soon revealed that it is constant in intensity across the sky. This implies the primeval universe was almost perfectly uniform, with the cosmic material spread evenly throughout space and expanding at exactly the same rate everywhere and in all directions. How did this state of near-perfect order come about?

One answer is simply to declare that the universe was 'made that way', i.e. the Big Bang was a synchronous explosion in which all regions of the universe expanded equally rapidly in precisely orchestrated unison. However, this seems suspiciously contrived. Moreover, it doesn't really explain anything. In the words of one cynic, it simply states that 'things are the way they are because they were the way they were'. Appealing to very special initial conditions to account for this or that feature of the universe simply serves to push the mystery back off the edge of time.

Similar arguments revolve around other unexplained features. One of these concerns the large-scale structure of the universe. Stars and gas are aggregated into galaxies, and the galaxies themselves are arranged in clusters and superclusters. On a very large scale, corresponding to distances of hundreds of millions of light years, the universe has a sort of frothy appearance, with galactic clusters strung out in filaments, or concentrated in sheets surrounding huge voids. This clumpiness of the universe today flies in the face of its smoothness in the primeval phase. If the universe began with matter distributed so smoothly, how did these vast aggregations of matter arise?

A partial explanation for the large scale structure is not hard to find. If a region of the universe is slightly denser than its surroundings, it will pull in more material by gravitational attraction. This in turn will add to its gravitating power and

"There has been insufficient time since the Big Bang for galaxies and clusters of galaxies to grow from a totally smooth initial state."

enhance the accreting effect. Thus gravity serves to amplify any initial variation in density. Over time, a hierarchy of clustering will grow. But this gravitational instability has to work against the overall expansion of the universe, which tries to draw matter apart. As a result it is a very slow process, and there has been insufficient time since the Big Bang for galaxies and clusters of galaxies to grow from a totally smooth initial state.

Cosmologists have responded to this difficulty with two suggestions. Maps of the universe reveal the distribution of luminous matter such as stars. But there may be a lot of matter in the universe that doesn't shine, either because it is invisible, or dark. For example, subatomic particles such as neutrinos go entirely unseen, while black holes or dim stars (called brown dwarfs) merge into the blackness of space. Dark matter will add to the gravitating pull of luminous matter and could help accelerate the clustering process.

The growth of structure could be accelerated if the clumps of matter had a head start, that is, if there were slight ripples in the hot primordial gases to start out with. The dense regions would then act as 'seeds' around which material could steadily accumulate. The degree of primordial clumpiness could not have been very great, because we know from the background heat radiation that the universe was very smooth initially. However, detailed calculations suggested that the merest hint of primordial unevenness would help a lot. So evidently the universe began in a state of almost but not quite perfect uniformity. Useful though this discovery was, it left a puzzle about the origin of the ripples. Where did they come from? Were they conveniently imprinted on the cosmos at the outset?

Rather than attribute the large scale cosmic order – overall smoothness dappled with slight irregularities – to *ad hoc*

initial conditions, it would clearly be more satisfying to find an explanation in terms of physical processes occurring in the primeval phase. About 1980 such an explanation was suddenly forthcoming. An American physicist named Alan Guth pointed out that if the universe had jumped abruptly in size by a very large factor during the first one second, then whatever the universe was like beforehand, it would end up

much as we observe it. For instance, if it began with an extremely irregular form, the huge distension would iron out the inhomogeneities and leave the universe pristine smooth, much as inflating a balloon eliminates the wrinkles. Guth dubbed this phase of rapid expansion 'inflation'. Slight variations from place to place in the degree of inflation might then, he suggested, account for the all-important ripples.

The inflationary scenario needed a plausible mechanism to drive the sudden expansion. The best idea did not come from cosmology, though, but from the field of sub-atomic particle physics. The 1970s had witnessed spectacular advances in the search for the ultimate building blocks of matter and an understanding of the fundamental forces that operate in the subatomic realm. Reduced to the most primitive level, four basic forces seem to exist in nature: gravitation and electromagnetism, familiar from daily life, and two nuclear forces called weak and strong. It has been an abiding dream among physicists that these four forces are somehow linked, so that

rather than representing four independent types of interaction between particles of matter, they would be four facets of a single underlying superforce.

As long ago as the 1820s Michael Faraday searched experimentally for a possible connection between electricity and gravitation. However, it was not until 1967 that an unmistakable link was established between two of the four

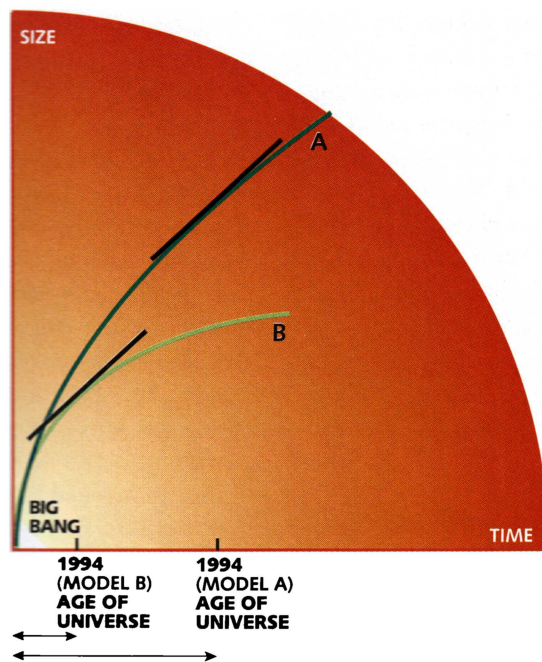


Figure 1. The expanding universe. The graphs shows how the size of a typical region of the universe grows with time in two alternative models of the universe. In both cases the expansion rate is explosive near the Big Bang and decelerates with time due to gravitational braking. Curve A shows a low-density universe, curve B a high-density universe. The slope of the tangent lines gives the rate of expansion observed today. Clearly the universe will fall to a given rate of expansion sooner in B than A, giving a lower estimate of the age today.

"It has been computed that in a few billion-trillion-trillionths of a second the universe would grow in size by more than a trillion trillion times."

forces. Steven Weinberg and Abdus Salam demonstrated mathematically how the electromagnetic force and the weak nuclear force might be connected, and experiments with very high energy particle collisions proved them right. Theoretical physicists soon afterwards cooked up a scheme to bring in the strong nuclear force, and finally gravitation too.

These theoretical studies suggest that the distinction between the four forces is due to the fact that we observe them at relatively low energies. When particles interact at very high energies, the different forces they experience begin to merge in identity. Amalgamation of the electromagnetic and weak nuclear forces has been achieved in particle accelerator experiments, but evidence for further mergers requires much higher energies and is so far lacking.

However, the Big Bang provided a sort of natural particle physics experiment. If the primeval universe was really as hot as cosmologists maintain then during the first split second the particles of matter may have had enough energy for all four forces to have been amalgamated into a superforce. As the cosmic inferno cooled, so the four familiar forces would have 'frozen out' one by one. It was from a study of this freeze-out process that a mechanism for inflation was discovered.

According to the most fashionable theory of force-merging, if matter cools from a very high temperature, the differentiation of forces does not happen smoothly. Instead, there is a sudden 'phase transition' of the sort that occurs when water freezes to ice. When water is cooled below zero degrees Celsius, the liquid phase becomes unstable, and ice suddenly starts to crystallise out. In the case of the early universe, it may happen that the matter gets 'hung up' for a while in an unstable early phase, and then abruptly 'freezes' into a state where forces become differentiated.

THE CONDITIONS IN THE VERY EARLY UNIVERSE WERE SO extreme that matter is better thought of as highly energised fields. In the hesitant condition just described, these fields exert an extraordinarily powerful repulsive force, which can be envisaged as a type of antigravity. In fact, the antigravity is so strong it completely overwhelms the normal attractive gravitation. As a result, the universe expands faster and faster, driven outwards by the powerful repulsion. This corresponds to Guth's inflation. It has been computed that in a few billion-trillion-trillionths of a second the universe would grow in size by more than a trillion trillion times. Being intrinsically unstable, the inflationary process lasts for only the briefest duration before the phase transition brings it to a stop, and the universe reverts to its more normal, less frenetic expansionary behaviour.

Inflation not only accounts for why the universe is so smooth, it also provides a natural explanation for the slight ripples needed to seed galaxies. Just as ice crystals in sub-zero water will start to form at slightly different times in different regions, so different parts of the universe may exit from inflation somewhat out of step. The result would be to reimpose slight irregularities on the smoothed-out state. Detailed calculations of the form of the ripples in this theory leads to an important prediction: the magnitude of the ripples should be the same on all length scales. In other words, big ripples shouldn't be more or less pronounced on average than small ripples.

Cosmologists have come to recognise that the consistency of the Big Bang theory turns on the existence and character of these primordial ripples. So far, I have been discussing them as a purely theoretical idea, but if they really existed they ought to have left an observable imprint on the cosmic background heat radiation. A careful study of the radiation should therefore reveal slight temperature variations across the sky: hot spots and cold spots reflecting the slightly uneven distribution of material in the early universe.

In 1989 NASA launched a satellite named COBE (for Cosmic Background Explorer) to search for the elusive ripples in temperature. Eagerly sifting the data, the project scientists initially found no trace of temperature variations. In fact, they established that the heat radiation is uniform to an astonishing degree – about one part in a hundred thousand. As the months rolled by and there was still no sign of the crucial ripples, cosmologists became increasingly nervous. Some of them prepared to dump the Big Bang theory altogether.

Then in April 1992 the project director, George Smoot, made a sensational announcement. The ripples had at last been found, at a level of a few parts per million. Furthermore, they had precisely the form predicted by the inflationary theory – the same on all length scales. The world's press went into a frenzy. Newsweek described the ripples as 'the handwriting of God'.

There is no doubt COBE has provided crucial confirmation of the Big Bang theory, and a welcome boost for the inflationary scenario. But it has brought with it a major snag: it makes the old problem of the cosmic time scale discrepancy even worse. To see why, it is necessary to take into account the fact that the universe does not expand at a constant rate. This is because gravitational attraction between the galaxies serves to restrain their dispersal, and tries to pull them back together again. Thus gravity acts as a brake on the expansion, causing the rate to slow down progressively with time. For example, about five billion years ago the universe was expanding at

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twice the rate it is today, while ten thousand years after the Big Bang the expansion rate was as much as a million times its present rate.

The magnitude of the braking effect depends on how much matter there is in the universe: the more matter, the greater the total gravitating power and the larger the deceleration. Astronomers estimate that the observable portion of the universe contains about a trillion trillion trillion tonnes of luminous matter. However, the COBE satellites and the inflationary scenario both suggest there should be roughly 100 times as much as this, the remainder presumably being in the form of dark matter.

Figure 1 compares the expansion profiles of these two scenarios. Curve A assumes there is no dark matter, curve B is the high-density, rapidly-decelerating universe suggested by COBE. Both graphs start out near the Big Bang with a high gradient, and gradually curve over due to gravitational braking. Hubble and his successors have measured the current rate of expansion, which corresponds to the slope of the curve at the present epoch. It is obvious from the graphs that curve B reaches a given slope at an earlier time than curve A. The age of the universe is the duration that has elapsed between the Big Bang and the point on the curve with the observed slope. Thus, in the COBE model the universe is considerably younger for a given rate of expansion today than is the case in the low-density model.

The actual ages in these two models depends on the numerical rate of expansion today, a figure known to astronomers as the Hubble constant. Hubble's student, the American astronomer Allan Sandage, quotes a figure of 50 kms per second per megaparsec for the Hubble constant. This means that a typical galaxy one megaparsec away (just over three million light years) recedes at 50 kms per second. Using Sandage's figure, the COBE/inflationary theory yields an age

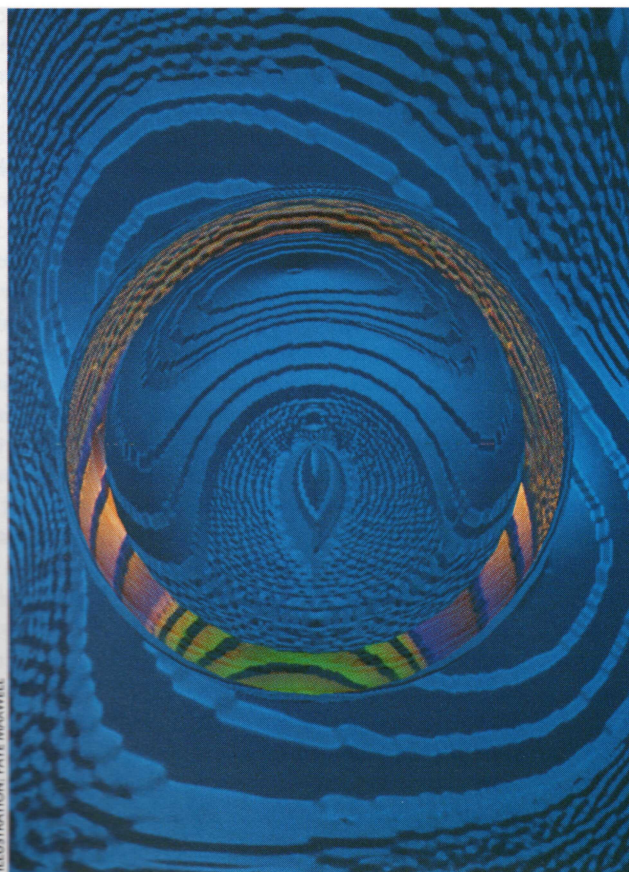
for the universe of about thirteen billion years – uncomfortably short if estimates of stellar ages (about 14 billion years) are correct. However, not all astronomers agree with Sandage. The French astronomer Gerard de Vaucouleurs has also measured the expansion rate and quotes a figure of 100 kms per second per megaparsec for the Hubble constant. If he is right, the universe is a mere eight billion years old, and the Big Bang theory is in serious trouble.

The mismatch that these figures represent is an embarrassing weakness in the Big Bang theory, and the subject of some anxious investigation. If the true value of the Hubble constant is around 35, cosmologists will breathe easily. Any higher, and the entire theory could go back into the melting pot. Given the large discrepancy between Sandage's figure and that of de Vaucouleurs, it is not inconceivable that the true value of Hubble's constant will be considerably lower than either, but that is pure conjecture.

Clearly, determining an accurate value for the Hubble constant is a major scientific priority. The main source of error in the measurement lies in the difficulty of knowing

the exact distances of the galaxies surveyed. Some galaxies appear nearer than they really are because they are intrinsically brighter than the average. It is only by identifying specific stars or other features within galaxies that accurate measurements are possible. Because of atmospheric disturbances, ground-based telescopes lack the resolution to identify individual stars in all but the very nearest galaxies.

Astronomers have therefore pinned their hopes on the Hubble space telescope. For three years they have endured the frustration of having an instrument with the power to resolve this tantalising cosmic mystery, but being prevented from using it. With the optical problems now sorted out, it should be only a matter of months before this impressive instrument puts an accurate date on the beginning of time – or scuppers the standard Big Bang theory for good. ★



A vision of science in the 21st century

Physics, the archetypal 'hard' science, is beginning to borrow the messy, complicated concepts of the biologist. In coming decades, the gap between physical and biological science will disappear

TWO CENTURIES GO THE FRENCH mathematician Pierre Laplace made an astonishing claim. Suppose, said Laplace, that there exists a superbeing who knows completely the state of the universe, including the position and motion of every atom, at one instant of time. Then by applying the laws of physics, the superbeing could determine precisely all future states of the universe, and also all past states: "both past and future would be present in his eyes". In other words, the entire history of the universe, from the beginning to the end of time, is completely fixed by its present state.

Laplace's startling conclusion is an example of mechanistic thought carried to the ultimate extreme. To arrive at it, Laplace drew upon the seminal work of Isaac Newton. According to Newton, the motion of all material systems obeys strict and deterministic mathematical laws. It is then but a small step to the vivid and powerful idea that the universe as a whole is a gigantic machine, whose future is unalterably fixed by its initial state.

For 300 years science lay in thrall of this sort of mechanistic thinking. In the 19th-century Industrial Revolution, engineers believed that almost anything could be achieved by constructing sufficiently large and complicated machines. Mechanistic language crept into all aspects of human affairs. Intellectuals began to talk about the military machine, the economic machine and the political machine. Karl Marx thought that if only the equivalent of Newton's laws for *social* behaviour could be discerned, then human destiny could be steered like a vehicle.

However, with the approach of the 21st century, the heady optimism of the Industrial Revolution has given way to deep pessimism and anxiety about the future. No longer do people think science has the power to tackle all human problems: indeed, it seems to create as many problems as it solves. We live in a world threatened by war, ecological disaster, overpopulation and the spread of AIDS. Faced with these uncertain challenges, scientists are starting to question the widespread use of the machine concept.

I believe we are about to enter the post-mechanistic age. Part of the reason for the current disillusionment with science and technology stems from the fact that people find mechanistic thought repugnant. If the universe is a machine, then human beings, who are part of nature, are apparently also machines. Indeed, scientists often tell us so: "We are survival machines," proclaims the Oxford biologist Richard Dawkins, "robot vehicles blindly programmed to preserve the selfish molecules known to us as genes." And the genetic processes themselves, operating at the molecular level, are described by Dawkins in terms reminiscent of automobile assembly lines. The trouble is, if we are merely elaborate automata, what becomes of free will and human qualities such as love and compassion? Much of the present backlash against science derives from the bleak-

ness of such a mechanistic world view.

Ironically it is physics, which originated the mechanistic paradigm, that is pointing the way to the post-mechanistic age. In the early part of the 20th century, quantum physics revealed that at the atomic level, matter does not behave deterministically as Newton and Laplace had supposed. More recently, the theory of chaos has shown that even on a large scale, matter may behave unpredictably or even randomly.

In the last few years, an entirely new sort of science has emerged: complexity theory. In traditional mechanistic science, a complex system is reduced to its simple components and the components are studied in isolation. The whole is treated simply as the sum of its parts. Complexity theory starts from the opposite assumption, recognizing that a snowflake, a neural network, a bacterium, or an ecosystem, derive their distinctive properties from the mutual interaction and cooperation of all their parts acting together. They cannot be decomposed without destroying some essential quality about them.

Complexity of this irreducible sort arises in fields as diverse as physics and chemistry, computing and economics, as well as biology. Many scientists suspect that there are certain universal laws for the behaviour of complex systems. Sometimes complexity takes the form of chaos, and common mathematical patterns have been discerned in systems as different as turbulent fluids and insect populations. On other occasions, complexity leads to a phenomenon known as 'self-organization', where a system leaps spontaneously into a state of greater organised complexity. One example is the laser, where disordered atoms cooperate to emit an extremely pure beam of light. Another are the strange rhythmic cycles that occur in certain complicated chemical reactions.

Scientists often use biological or ecological language to describe the behavior of complex

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systems, even though they may be non-living. Words like cooperation, exploration, evolution and adaptation seem appropriate. Complex systems often seem to

act 'intelligently', reacting to changes and adapting themselves spontaneously almost as if they were living. The concept of Gaia, popularised by James Lovelock, is a good example. Here, the Earth as a whole, including its atmosphere and oceans, is regarded as an integrated feedback and control system. The biosphere interacts with the larger system to ensure stability and the opportunity for life to flourish.

THROUGH THE NEW SCIENCE OF complexity, physical scientists are appropriating the language and concepts of biology at the same time as the biologists are using the physicist's outmoded mechanistic ideas! It is becoming increasingly clear that the distinction between machines and organisms, and between the physical and biological sciences, is disappearing. I believe that by the middle of the next century, science and the world view of all humanity will be transformed by this development.

We can already see the new concepts at work in the shape of 1990s technology. A hundred years ago, wealth came to those nations that could mine coal and iron, build ships and railways, and harness steam power. Today, the wealth-creating industries are those based not on machines but on *information*. The flow of information around the globe, whether in the form of money, expertise, education or entertainment, is worth more than all the world's supertankers.

An information network is a web of complexity that transcends a simple mechanistic description. In an electronic system or an optical fibre, it is not the movement of material particles that is significant but the swirling patterns of information. It is a widespread myth that informational networks such as national or global economies are machines that can be steered by politi-

cians. They are in reality self-organizing systems that have a life of their own. National economic planning in the 21st century will model itself more on an adaptive ecosystem than on the popular analogy of a ship with a government minister at the helm. This will lead to totally new ways of thinking about the global economy and the relationship between First and Third World societies.

The digital computer, which many people regard as just a sophisticated machine, is the symbol of 1990s science. However, the way forward in the search for more 'intelligent' computers seems to lie with the concept of neural nets. Neural computing closely models the brain in its organizational structure. The brain is an almost random network of – in essence – wires and switches, in which complex patterns of electrical activity circulate and organise themselves spontaneously. Computer scientists are developing artificial neural nets that avoid the rigid mechanistic behaviour of conventional computers and, like the brain, can adapt and learn from experience.

In the coming decades, as neural computing becomes more powerful and miniaturised, the distinction between artificial and natural biological systems will fade away. Computer scientists will make increasing use of organic materials in their systems, growing neural network components using biotechnology. Conversely, their products will be implanted into human brains or nervous systems to boost performance and combat degenerative diseases.

As for the machines of the future, we shall doubtless still want bicycles, dishwashers and cars. But the leading-edge technology will focus on micromachines: devices that will become so small and 'clever' that they will no longer really be machines at all, but

rather 'smart matter' – just like micro-organisms. Several recent developments indicate the possibilities. An electrical motor has been produced that is too small to see with the unaided eye; the scanning-tunnelling electron microscope is capable of moving individual atoms around, and molecular beam epitaxy enables scientists to build entirely new materials, atomic layer by atomic layer.

The name 'nanotechnology' has been coined for engineering on a scale of nanometres (billionths of a metre) – about the size of a large molecule. Some scientists foresee a time when nano-devices will be injected into the human body to carry out repair and maintenance functions at the cellular level. If this sounds fantastic, remember that designer drugs are already doing this, albeit in a somewhat haphazard manner. What is exciting is the possibility of creating microscopic systems that will respond 'intelligently' and co-operate with each other in the biological environment in the way that healthy organs do. Such microsystems would be able to attack viruses and improve many bodily functions.

This merging of the non-living and the living, the mechanistic and the organic, will have as big an impact on society as either the Copernican or Industrial revolutions. Some people may find the prospect frightening, but in my opinion it holds out great hope for mankind, and for our view of our place in the cosmos. Ancient cultures always regarded humanity as an integral part of nature. The rise of mechanistic science served to alienate people from the universe that is their home. By rejecting

the machine paradigm, we recognise that human beings and their society have a value that is more than the sum of their component parts. And by regarding the cosmos not as a gigantic clockwork but as an extended ecosystem, mankind can once again be fully integrated into nature. ★

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TEENAGE SEX IN THE AGE OF AIDS: Susan Moore is a psychologist and senior lecturer in the Faculty of Education at Monash University. Doreen Rosenthal is a psychologist and Director of the Centre for the Study of Sexually Transmissible Diseases at La Trobe University. They are co-authors of a new book, *Sexuality In Adolescence*. The interviewer, Jenny Brown, is a Melbourne journalist.

REVEALED: HOW THE GLOSSIES DO IT!: Rosslyn Beeby is a Melbourne-based writer and free-lance journalist. She is the author of a popular book on environmental action.

THE CANCER EPIDEMIC: Graham Giles is the Director of the Cancer Epidemiology Centre at the Anti-Cancer Council of Victoria, and the Director of the Victorian Cancer Registry. He is the chief investigator of the Melbourne Collaborative Cohort Study, a 20-year prospective health study of 50,000 Melburnians.

GENES, DREAMS AND VACCINES: Tony Burgess is Director of the Melbourne branch of the Ludwig Institute for Cancer Research, and Professor of Cell Biology in the Department of Surgery at the University of Melbourne. Prof Burgess was the first scientist to purify a hormone which regulated blood-cell production. His current research includes investigating the hormonal changes that accompany colon cancer.

OUTGUESSING THE ALIENS: David Blair is an Associate Professor in the Department of Physics at the University of Western Australia. He is leader of a research team studying aspects of gravitational radiation antennae.

THE HIGH-DEFINITION OLYMPICS: HD-TV AND SYDNEY 2000: Kent Wildish is a curator at the Powerhouse Museum in Sydney. He is completing a PhD in biomedical engineering on ion beam modification of artificial substances.

MUSIC OF THE MIND: Rick Slaughter is a futurist, author and academic. He is Lecturer in Futures and Social Education at the Institute of Education, University of Melbourne.

THE SUPERHIGHWAY TO A SEE-THROUGH SOCIETY and GATES' EXPEDITION TO THE LIVING ROOM: Sandy Plunkett is the information technology writer and editor of 'IT Review' at *Business Review Weekly*.

LEARNING TO LIVE WITH TECHNOLOGY: Hugh McKay is a psychologist and social researcher, and the founder of McKay Research and the Centre for Communication Studies. He is the author of a best-selling book, *Re-inventing Australia*.

INFORMATION HAS A PRICE: Don Lamberton is Visiting Fellow, Urban Research Program, Research School of Social Sciences at the Australian National University. He is general editor of *Prometheus*, co-editor of *Information Economics and Policy*, and a member of the editorial boards of several journals in the fields of communication technology and futurology.

A NEW ERA FOR HOME MUSIC: Ian Richardson is a musician and computer programmer. He once played in a garage band in Morwell, Victoria.

TELECOMMUNICATIONS TRENDS: Peter Gerrand is Professor of Telecommunications at the Royal Melbourne Institute of Technology (RMIT), and chief executive officer of the Collaborative Information Technology Research Institute (CITRI).

TOOLS FOR TOMORROW'S TELECOMMUNICATIONS and INTERNET: THE NETWORK OF NETWORKS: Stuart Dunstan is an electronics engineer employed by Siemens Ltd in Melbourne. In 1990 he joined the government-funded Universal Video Codec (UVC) project at Monash University as a Siemens representative.

THE COMPACT MEDIUM: Nicholas Thorpe is project manager for Glasshouse Media, a division of Shomega Ltd, a Melbourne-based communications company.

VOICE COMPUTERS TALK MONEY: Paul Hendy is a Canberra-based free-lance researcher and part-time tutor in social analysis at the University of Technology, Sydney.

THE NET: PROMISE OR THREAT?: Andrew Garton is a working composer and performer and the co-ordinator of user services at Pegasus Networks in Brisbane. His e-mail address is <agarton@peg.apc.org>

THE CURSE OF E-MAIL and PHONE POLITICS: MAKING TELECOMMUNICATION POLICY: Richard Joseph is a lecturer in the Department of Information and Communication Technology at the University of Wollongong. He has worked for the Federal Government in the area of science and technology policy and at the Organisation for Economic Cooperation and Development (OECD) in Paris.

THE IT CHALLENGE TO RETAIL BANKING: Vic Edwards is a lecturer in the School of Banking and Finance at the University of New South Wales. He is a former general manager of Aetna Investment Management (Australia) Ltd and former executive director of the Permanent Building Societies Association (NSW) Ltd.

OVERCHOICED AND UNDERSOLD: David Amdal is the marketing director of BIS Shrapnel, an international forecasting and market intelligence firm. He specialises in the field of new media. His e-mail address is Applelink AUST0773.

THE BIRTH OF THE UNIVERSE and A VISION FOR SCIENCE IN THE 21ST CENTURY: Paul Davies is Professor of Natural Philosophy at the University of Adelaide and a best-selling author of over 20 books, the latest being *The Mind of God*.

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